NERT – SNWA Weir Dewatering Water Treatment Plant
Operation and Maintenance Manual
Nevada Environmental Response Trust Site
Henderson, Nevada

PREPARED FOR

Nevada Environmental Response Trust
35 E. Wacker Drive, Suite 1550
Chicago, IL 60601

PRESENTED BY

Tetra Tech, Inc.
150 S. 4th Street, Unit A
Henderson, NV 89015

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LIST OF ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
CWTP	Central Water Treatment Plant
Evoqua	Evoqua Water Technologies, LLC
DLV	Deliverable Schedule for Reports, Plans, and Other Submittals
DMR	Discharge Monitoring Report
g/cc	grams/cubic centimeter
gpm	gallons per minute
HLDS	Historic Lateral Dewatering Site
HLPS	Historic Lateral Pump Station
HMI	human machine interface
IOM	Installation, Operation and Maintenance
M&R	measure and report
mg/L	milligrams per liter
µg/L	micrograms per liter
NDEP	Nevada Division of Environmental Protection
NERT	Nevada Environmental Response Trust
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
PLC	programmable logic controller
ppb	parts per billion
ppm	parts per million
psig	pounds per square inch gauge
PSV	pressure safety valve
SMDS	Sunrise Mountain Dewatering Site
SMPS	Sunrise Mountain Pump Station
SNWA	Southern Nevada Water Authority
SSO	sanitary sewer overflows
TDH	total dynamic head
TDS	total dissolved solids
TSS	total suspended solids

CERTIFICATION

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been prepared in a manner consistent with the current standards of the profession, and to the best of my knowledge, comply with all applicable federal, state, and local statutes, regulations, and ordinances.

Description of Services Provided: Prepared operations and maintenance manual for the SNWA Weir Dewatering Treatment Plant.

Kyle J. Hansen

June13, 2018

Kyle Hansen, CEM
Field Operations Manager/Geologist
Tetra Tech, Inc.

Date

Nevada CEM Certificate Number: 2167
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1.0 INTRODUCTION

The Southern Nevada Water Authority (SNWA) is constructing two new weirs on the Las Vegas Wash, the Sunrise Mountain Weir and Historic Lateral Weir. SNWA has hired a construction company to construct the new weirs. SNWA's contractor is building diversion channels to divert the Las Vegas Wash during the construction activities. The diversion channels are to the south of the Sunrise Mountain Weir and to the north of the Historic Lateral Weir, respectively.

The construction dewatering activities are near where a perchlorate groundwater plume originating from the Nevada Environmental Response Trust (NERT) site intersects the Las Vegas Wash. NERT is responsible for treating the groundwater from the construction dewatering activities to remove perchlorate before it can be discharged back to the Las Vegas Wash.

To manage and treat groundwater from the construction activities, Tetra Tech has designed two pump stations and a central water treatment plant (CWTP), collectively referred to as the SNWA Weir Dewatering Water Treatment Plant (Treatment Plant). The treatment plant will operate on a temporary basis, and operations will cease once groundwater dewatering associated with the SNWA weir construction projects is complete.

At the direction of the Nevada Environmental Response Trust (NERT or Trust), Tetra Tech, Inc. (Tetra Tech) has prepared this Operations and Maintenance Manual (O&M Manual) for the Treatment Plant.

1.1 PURPOSE

The purpose of this O&M Manual is to provide procedures for operations and maintenance of the Treatment Plant to manage and treat groundwater from the SNWA construction activities. This O&M Manual presents the following:

1. A description of the treatment process;
2. A summary of operational requirements;
3. Operational and troubleshooting guidance;
4. A summary of maintenance requirements;
5. The start-up sequence;
6. The shut-down sequence;
7. A summary of the regulatory framework;
8. A description of data collection and management requirements;
9. Sample calculations; and
10. A summary of health, safety, and security requirements.

Note that all values in this Revision 0 of this O&M Manual will be finalized during commissioning and initial startup activities. This O&M Manual will then be updated to include those values.

1.2 SITE LOCATION AND DESCRIPTION

The SNWA weir construction projects are located in the Las Vegas Wash approximately 3 miles northeast (downgradient) of the NERT site. The Sunrise Mountain and Historic Lateral weir construction locations are located approximately 2,000 feet (ft.) west and 3,000 ft. east of Pabco Road (Figure 1). The SNWA construction areas and easements associated with weir construction encompass approximately 75 and 40 acres, respectively for the Sunrise Mountain and Historic Lateral Weirs, including the weirs, temporary surface water diversion channels, and bank areas. SNWA's contractor will transfer the water to the Trust at a separate handoff location for each weir. The Sunrise Mountain water handoff is located approximately 500 feet southeast of its respective surface water diversion channel and the Historic Lateral weir handoff is located approximately 1,100 feet south of its respective surface water diversion channel.

2.0 TREATMENT PROCESS DESCRIPTION

The groundwater generated from the SNWA weir construction operations is anticipated to be contaminated with low concentrations of perchlorate. NERT is responsible for treating the groundwater before discharge to the Las Vegas Wash under the existing National Pollutant Discharge Elimination System (NPDES) permit.

The Treatment Plant was designed to primarily remove perchlorate from groundwater and manage total suspended solids (TSS). The Treatment Plant includes two pump stations and the CWTP that consists of cyclone separators to remove large solids, Multi-Media Filters to remove finer solids, followed by an Ion Exchange System to remove perchlorate. The cyclones and Multi-Media Filters are included to protect the Ion Exchange System against plugging and short circuiting. Solids going through the Ion Exchange System can short circuit the resin bed and prematurely deactivate the resin within the ion exchange tanks. Site plans are provided on Figures 2, 3, and 4. The Process Flow Diagram (PFD) for the Treatment Plant is included in Appendix A.

Dewatering for weir construction is being conducted by SNWA's contractor. The dewatering means and methods are determined by the contractor, and are not dictated by SNWA and are outside of the control of NERT. For the Treatment Plant design, the Nevada Division of Environmental Protection (NDEP) directed the Trust to assume that the dewatering will not exceed a combined maximum flowrate of 6,900 gallons per minute (gpm) from dewatering operations at the two weirs under simultaneous construction.

2.1 PUMP STATIONS

As noted above, the Treatment Plant includes two pump stations. One pump station is located in the vicinity of the Sunrise Mountain weir and is identified as the Sunrise Mountain Pump Station (SMPS). The other pump station is located in the vicinity of the Historic Lateral weir and is identified as the Historic Lateral Pump Station (HLPS). The groundwater generated from the construction activities at the Sunrise Mountain weir is transferred by the SNWA's contractor to five 20,100-gallon Baker-type influent tanks (Influent Tanks) installed at the SMPS. The groundwater generated from the construction activities at the Historic Lateral weir is transferred by SNWA's contractor to four Influent Tanks installed at the HLPS.

At each pump station, a flow meter measures instantaneous and totalized flow entering the pump station. The flow meter readings from each pump station are monitored at the control system to ensure the total flow between the two pump stations does not exceed the maximum design flow of 6,900 gpm. An on/off control valve is also installed on the lines transferring water from the weirs to the pump stations. During emergency conditions, the valves can be shut off to prevent water from entering either pump station.

Also at each pump station, an online TSS meter continuously measures the TSS in the water entering the pump station. A polyblend type polymer system is installed at each pump station. If TSS concentration in the incoming water rises above 500 parts per million (ppm), the operator has the option of starting the polymer system at each pump station. The polymer is used to improve the settling characteristics of solids in the Influent Tanks. If polymer is added to the water entering the pump station, solids are expected to settle to the bottom of the influent tanks. A vacuum truck may be used periodically to remove the solids that have settled in the Influent Tanks. The operator shall monitor the level of the settled solids in the tank and make the determination if the solids will need to be removed. The solids removed by the vacuum truck shall be disposed offsite. The Influent Tanks at each pump station are also used to provide equalization and storage capacity.

Three pumps are used to pump water from each pump station to the CWTP. The pumps operate automatically based on water level in the Influent Tanks. As the water level drops to a certain level in the Influent Tanks, the pumps stop operation. As the water level in the Influent Tanks rises to a certain level, the pumps start operation. The water from both pump stations is combined in a single line at the CWTP.

The influent pumps at the pump stations are end-suction centrifugal pumps. The pumps at SMPS are sized for a flow rate of 2,300-gpm and a duty point total dynamic head (TDH) of 360-ft. The pumps at HLPS are sized for a flow rate of 2,300-gpm and a duty point TDH of 460-ft. The pumps are manufactured by Flowserve and the model number is 6HPX12C FPD-S-6.

2.2 CENTRAL WATER TREATMENT PLANT

A flow meter at the CWTP measures the instantaneous and totalized flow of the combined water before treatment. As noted above, the Treatment Plant is designed to treat a maximum flow of 6,900 gpm. If the flow rate of combined water at the CWTP rises above 6,900 gpm, the SNWA operator should be notified immediately that too much water is being delivered to the pump stations. The control valves can be actuated to open and close gradually to reduce flow from that pump station. The valve will be adjusted to limit the total flow to 6,900 gpm.

2.2.1 Coagulant Addition

Ferric chloride will be added to water leaving the Sunrise Mountain Pump Station (SMPS). Ferric chloride is a coagulant that will neutralize charges between particles that are contained in the influent water. Ferric chloride should be added to influent water when the TSS concentration in the influent water exceeds the discharge limit of 135 mg/L for TSS. Adding coagulant to water significantly improves the effectiveness of polymer in flocculating colloidal solids in water. When the TSS concentration in the influent water is higher than 500 mg/L, polymer alone is effective in forming flocs. However, at TSS concentration below 500 mg/L the TSS flocculation improves significantly when 10 mg/L ferric chloride is used as coagulant. Ferric chloride can also improve coagulation of colloidal material contained in influent water even at very low concentration. Use of coagulant at these concentrations improves the removal of colloidal solids at the media filters, reducing the quantity of solids that may become trapped in the ion exchange resin, which can reduce the life of the resin. Tests have indicated that ferric chloride used as coagulant at 10 ppm concentration is effective at TSS concentration up to 3,000 mg/L. When the operator decides to add coagulant to the influent water, he must make sure the polymer is also added, since coagulant addition alone will not be effective in improving removal of TSS without polymer addition.

A metering pump will be used to add ferric chloride to the influent water leaving the SMPS. At 5,000 gpm water flow and 10 mg/L ferric chloride, the metering pump would have a capacity to pump approximately 2 gph ferric chloride. A pump with a higher hydraulic capacity (up to 3 gph for 7,500 gpm) should be used to handle variation in influent water flow rate above 5,000 gpm.

2.2.2 Cyclone Separators

At the CWTP, the combined water first passes through two cyclone separators in parallel. The cyclones are designed to remove large solids particles larger than 10 microns with specific gravity greater than approximately 2 grams/cubic centimeter (g/cc), such as sand. The cyclones are designed to run at a maximum flowrate of 6,900 gpm. An online TSS meter continuously measures TSS in the combined water line. The following operational decisions are dependent on the TSS concentration in the water (see Section 3.3.1.2 for more detailed discussion):

- Turn the polymer system on/off at either or both pump stations;
- Change the orifice on the cyclone underflow; and/or
- Divert the cyclone underflow to the Cyclone Waste Tanks or Backwash Waste Tank.

Each of the two cyclones has three chambers for a total of six chambers. A total of 120 2.5-inch cyclone units are installed in the chambers. Depending on the total flow and pressure drop across the cyclones, the water flow is distributed between the six chambers. The centrifugal force generated within the cyclones separates solids from water. The overflow leaves the cyclones from the top. The underflow containing solids leaves the cyclones from the bottom. The underflow shall initially be routed to the Cyclone Waste Tank. As the Cyclone Waste Tank starts to fill, the underflow shall be routed to the Backwash Waste Tank. Also, depending on the solids concentration in the cyclone underflow, the operator can manually switch the cyclone underflow from a smaller orifice opening to a larger orifice opening. With the smaller orifice opening, the cyclone underflow flow rate is limited to approximately 10 gpm. With the larger orifice opening, the cyclone underflow flow rate can range from 38-100 gpm.

2.2.3 Multi-Media Filter System

The overflow from the cyclones is sent to the Multi-Media Filter system. An online TSS meter continuously measures the TSS in the water entering the filtration system. The Multi-Media Filters system is designed to remove residual TSS that is not removed by the cyclones. These are solid particles with specific gravity smaller than 2.0 g/cc. The Multi-Media Filters system consists of three tanks, each tank consisting of two chambers. The six chambers are operated in parallel. The hydraulic capacity of each chamber is approximately 1,150 gpm. The media inside the chambers consist of three layers of gravel, sand, and anthracite. As the solids are removed by the filters, the pressure drop across the chambers rises. The filters can be backwashed based on production time or pressure drop across the filter media. The frequency of backwash can be changed by the operator based on solids concentration in the influent water entering the filters. The TSS concentration in the backwash stream is also an important parameter that should be used to determine the frequency of the backwash. Based on the solids loading into the MMF and the TSS concentration in the backwash stream, the operators can determine the frequency of backwashes. If desired, the operator can manually start the backwash from the MMF SCADA system. The reason for using different strategies for backwashing media filters is the solids load. If the filters receive much higher solids load than their design capacity they will leak solids to the ion exchange system. The cyclones and media filters must be used to keep the ion exchange system from receiving high solids. The best way to determine if the media filters are clean enough is to monitor the TSS concentration in the backwash.

Clean water stored in the Treated Water Tanks (see Section 3.3.8.1) is used to backwash the chambers. One filtration chamber is backwashed at a time. While a chamber in in the backwash mode, the control system will not allow another chamber to go into backwash mode. Before the chambers are backwashed, they are initially rinsed with clean water to remove water that is contaminated with perchlorate from the filter chambers. The rinse water is stored in a Rinse Water Transfer Tank, and ultimately sent through the Ion Exchange System to remove perchlorate. After rinsing the chambers, the chambers are backwashed. A flow meter continuously measures the instantaneous and total flow for the backwash stream. The frequency of backwash depends on the TSS concentration in the feed water. The Multi-Media Filters system is designed for an influent TSS capacity of 40 ppm. If TSS rises above this value, more frequent backwashes would be needed. The system may be able to handle short-term increase in backwashing frequency, but extended durations of high influent TSS and frequent backwashing will likely reduce the overall flow capacity of the system. Backwash waste is sent to the Backwash Waste Tank.

2.2.4 Ion-Exchange System

Water leaving the Multi-Media Filter system goes through an Ion Exchange System, the main treatment process for removing perchlorate. The Ion Exchange System consists of three trains, and each train consists of two tanks. One of the tanks is considered the lead tank while the other is considered the lag tank. The hydraulic capacity of each train is approximately 2,300 gpm. The lead/lag tanks are operated in series. The lead tank removes the bulk of the perchlorate from water. The lag tank is used to polish the water before discharge. The operator must collect samples of the water leaving both the lead and lag tanks and submit for laboratory analysis of perchlorate. This analysis serves the following two purposes: 1) It ensures that the discharge water meets the NPDES limit for perchlorate; and 2) It signals to the operator when the resin in the lead tank is getting close to being spent and needs to be replaced with fresh resin. When the perchlorate in the discharge from the lead resin reaches 50 percent of the perchlorate concentration in the feed water, the resin is considered to be spent. The operator must contact Evoqua Water Technologies LLC (Evoqua) and coordinate with Evoqua to replace the resin in the lead tank with fresh resin. When the resin in the lead tank is replaced with fresh resin, this tank becomes the new lag tank and the old lag tank becomes the new lead tank. The lag tank always contains the newest resin. Switching the tanks between lead and lag is performed by Evoqua after replacing the resin by opening and closing valves on the ion exchange skids. If the groundwater has high TSS concentration and the upstream Cyclones and MMF are saturated with solids, some of the solids may break through the MMF and bleed into the Ion Exchange System. If this happens over an extended period, the solids trapped in the ion exchange vessels will cause higher pressure drop across the vessels. Under this condition, the resin will require replacement to avoid excessive backpressure build up in the CWTP. The operators shall monitor the pressure levels in the CWTP and the pressure drop across the Ion Exchange System to identify if a resin replacement is required.

2.2.5 Treated Water Storage and Discharge

Treated water leaving the Ion Exchange System is sent to four 20,100-gallon Baker-type tanks (Treated Water Tanks) to store the treated water before discharge to the Las Vegas Wash. These tanks also supply clean water for rinsing and backwashing the Multi-Media Filters. Three effluent pumps are used to pump treated water from the Treated Water Tanks to the Las Vegas Wash. These pumps are end-suction centrifugal pumps manufactured by Flowserve (model number 3510x8-14RV M3 ST). These pumps are sized for 2,300 gpm and a duty point TDH of 23.1 ft., and operate based on water level in the tanks. An online TSS meter installed on the discharge pipe continuously measures the TSS in the discharge water. The NPDES discharge limit for TSS is 135 ppm. A flow meter continuously measures the instantaneous and totalized flow of the discharge stream.

One of the design features of the Treatment Plant is that the solids that have been removed by the cyclones and the Multi-Media Filters are re-blended with the treated water before the treated water is discharged to the Las Vegas Wash. However, in blending these solids with the treated water, the following factors need to be considered:

1. The cyclone underflow stream contains perchlorate; therefore, care must be taken to ensure that the contribution from the cyclone underflow waste stream to the perchlorate in the treated water is not high as described further below; and
2. The rate at which the backwash waste is blended with the treated water must be monitored closely to ensure that the TSS in the discharge stream is less than the NPDES permit limit of 135 ppm.

To ensure that the perchlorate contained in the cyclone underflow waste stream does not cause compliance issues in the treated water discharge, efforts must be made to keep the cyclone underflow rate at approximately 10 gpm (see Section 3.3.2.1). If the TSS concentration in the feed water entering the CWTP is lower than 120 ppm, the cyclone underflow waste should be diverted to the Backwash Waste Tanks. Therefore, under these operating conditions, the Backwash Waste Tanks will contain the cyclone underflow waste and the backwash waste. If the influent water contains high solids, then the cyclone underflow should be diverted to the Cyclone Waste Tank. Progressing cavity pumps are used to pump the waste from the Cyclone Waste Tank to the Backwash Waste Tank. Variable speed pumps are used to pump the waste stream from the Backwash Waste Tanks to the discharge pipe. A mass balance on TSS and perchlorate should be made to determine the rate at which the waste stream from the Backwash Waste Tanks should be pumped to the discharge pipe. If the TSS concentration in the feed water is higher than 120 ppm, the cyclone underflow will be directed to the Cyclone Waste Tank. Based on the mass balance calculations, the decision is made to either bleed the waste stream from the Backwash Waste Tanks or send the contents to a holding tank for off-site disposal.

2.3 EXPECTED INFLUENT CHARACTERISTICS

This subsection describes the expected groundwater quality and flow characteristics for the influent flow from the weir construction dewatering.

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2.3.1 Groundwater Quality

The quality of groundwater from the weir construction projects was estimated based on assessment of historic groundwater quality data provided by Ramboll Environ and SNWA from samples taken from nearby monitoring wells in 2015 and 2016, and from dewatering water quality data provided by SNWA generated from two previous weir construction projects in the Las Vegas Wash. The previous dewatering water quality data provided by SNWA included one to two sample events for select parameters for each weir. The groundwater quality characterization included a review of data from monitoring wells close to the proposed Sunrise Mountain and Historic Lateral weirs. The groundwater generated at the weir construction sites is expected to contain a wide variety of contaminants, including perchlorate, chloride, sulfate, chlorate, and other inorganic compounds. Total organic carbon represents the organic content of the groundwater. However, NERT is only required to treat perchlorate and chlorate as the other constituents are not associated with the NERT site. The following table presents the average and maximum values for various parameters based upon the historic information described above. The groundwater characteristics of water sent to the Treatment Plant may differ from the values presented below.

Table 1 Expected Groundwater Characteristics

Parameter	Units	Value	
		Average	Maximum
Perchlorate	ppm	1.3	1.8
Sulfate	ppm	1,175	1,700
Chlorate	ppm	0.43	0.47
Chloride	ppm	493	625
Magnesium	ppm	110	135
Potassium	ppm	33	37
Sodium	ppm	510	640
Calcium[1]	ppm	420	-
Nitrate-NO_3	ppm	30	36
Total Dissolved Solids	ppm	3,050	4,150
Total Suspended Solids	ppm	12	14
Total Organic Carbon	ppm	2.1	2.5

Note: [1] – Only one sample result available.

2.3.2 Groundwater Flow Rate

SNWA provided dewatering information including flowrate and durations observed during construction of ten weirs in the Las Vegas Wash between 2004 and 2014. The dewatering flow range at all the weirs (except Three Kids Weir) ranged from 4 gpm to 2,453 gpm. The Three Kids Weir is an exception, with a flow rate ranging from 1,174 gpm to 7,077 gpm; this higher dewatering flow rate is attributed to a non-conventional weir construction technique and infiltration of a significant amount of surface water. The average dewatering flow for all ten weirs is 849 gpm. Including only the two weirs located nearest to the proposed Sunrise Mountain weir and two weirs located nearest to the Historic Lateral weir shifts this average dewatering rate to 926 gpm. SNWA, in a June 2016 meeting with the Trust, estimated that their "best guess" range of dewatering per weir for the Sunrise Mountain and Historic Lateral weirs would be 500 – 1,250 gpm (each). At the direction of NDEP, however, the Treatment Plant design assumes simultaneous inflows from both weir projects will not exceed a combined 6,900 gpm. For this reason, the designed Treatment Plant has the capability to adjust for varying flow rates between 4,600 gpm and 6,900 gpm. The treatment system has been designed to handle a minimum flow of 4,600 gpm. This flow rate to the CWTP is maintained by controlling operation of the Influent Pumps at SMPS and HLPS as described in Section 3.1.2 and Section 3.2.2. In the event that the combined flow to SMPS and HLPS is less than 4,600 gpm, the influent water will be stored in the Influent tanks in the pump stations. Pumping activity will resume when the Influent pumps at SMPS and HLPS can pump at least 4,600 gpm to CWTP.

3.0 OPERATIONS

This section presents a summary of the operations procedures and process control descriptions.

3.1 SUNRISE MOUNTAIN PUMP STATION

3.1.1 Groundwater Collection

Five 20,100-gallon Influent Tanks (TK-1A, 1B, 1C, 1D, and 1E) are installed at the SMPS to receive groundwater generated at the Sunrise Mountain weir construction site. SNWA's contractor is responsible for transferring the groundwater from the weir construction site via pipeline to the SMPS. SNWA's contractor will install a by-pass line at their battery limits on the groundwater transfer line that under emergency conditions can return the untreated groundwater to the Las Vegas Wash instead of sending it to the pump station. The bypass line is equipped with a pressure relief valve which will open when the pressure in the transfer line is increased. Under emergency conditions (when the Valve XV-2010 on the inlet line to the SMPS storage tanks is closed) the pressure in the transfer line from the weir construction site will increase and open the pressure relief valve, thereby diverting the water to the Las Vegas Wash.

A polymer system is installed at each pump station. The polymer system can be operated manually or automatically. Under automatic operational mode the polymer system would start based on TSS concentration in the incoming water. Under manual operating condition, the operator would start the polymer system from the SCADA system. At high TSS concentrations (i.e. 500 ppm or above), the operator has the option of starting the polymer system at each pump station. The Influent Tanks are equipped with a discharge nozzle at the bottom of each tank. The nozzles are equipped with quick connects. Once per week, a hose connection will be used to remove the settled solids into a vacuum truck which will take solids off-site for disposal.

3.1.1.1 Influent Flow

One magnetic flow meter (FM-2010) and one electrically actuated flow control valve (XV-2010) are installed on the influent pipe to the Influent Tanks (TK-1A, 1B, 1C, 1D, and 1E) at the SMPS. FM-2010 will provide instantaneous and totalized flow for the groundwater entering these Influent Tanks. XV-2010 will control flow entering the Influent Tanks and is normally OPEN. Operations are as follows:

- FM-2010 will measure instantaneous flow entering Influent Tanks TK-1A, 1B, 1C, 1D, and 1E.
  - Instantaneous flow is sent to the SMPS Control Panel, where it is totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
- The reading from FM-2010 is summed with the readings from flowmeter FM-3010 installed at HLPS to indicate the total flow entering the two pump stations.
- When the instantaneous total flow rate measured by FM-2010 and/or FM-3010 exceeds a pre-set value of 6,900 gpm for 30 seconds:
  - Flow Control Valve XV-2010 will close if the flow measured by FM-2010 exceeds 6,900 gpm for 30 seconds. If the flow combined flow measured by FM-2010 and FM-3010 exceeds 6,900 gpm for 30 seconds, the Flow Control Valve XV-3010 will be throttled down so that the total flow entering SMPS and HLPS does not exceed 6,900 gpm.
  - High-Flow Alarm is generated. The alarm is transmitted from the SMPS Control Panel to the Master Control Panel and then to the operator via the Auto-Dialer.

- The Operator shall contact weir general contractor and inform them the flow has exceeded 6,900 gpm.

3.1.1.2 Influent Total Suspended Solids

One online real-time TSS monitor (AIT-2010) is installed on the feed line transferring groundwater from the Sunrise Mountain weir construction site to the SMPS. AIT-2010 will provide instantaneous TSS readings of the water coming from the construction site. Under the automatic operational mode for TSS control, the SCADA system has been programmed to operate as follows. However, based on actual field conditions the operator may decide to operate the TSS control logic manually

- AIT-2010 will measure the instantaneous Total Suspended Solids (TSS) concentration of groundwater being generated from the weir construction site.
  - Instantaneous TSS readings are sent to the SMPS Control Panel, and the Master Control Panel at CWTP. The TSS reading is recorded and kept for 730 days.
- When the instantaneous TSS reading measured by AIT-2010 at SMPS exceeds 120 ppm for 5 minutes:
  - High-TSS Alarm is generated. The alarm is generated by the SMPS Control Panel and transmitted to the Master Control Panel and then to the operator via the Auto-Dialer.
- When the instantaneous TSS reading measured by AIT-2010 at HLPS exceeds 500 ppm for 5 minutes:
  - High TSS alarm shall be generated. The alarm shall be generated by the HLPS Control Panel and transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.
  - The polymer system CH-1 shall start and add polymer to the water line before entering the storage tanks.
  - If the TSS measured by AIT-2010 drops below 500 ppm for 5 minutes. The polymer system CH-1 shall stop.

3.1.1.3 Influent Tank Level Measurement

Five 20,100-gallon Influent Tanks (TK-1A, 1B, 1C, 1D, and 1E) are used to store groundwater that is generated from the Sunrise Mountain weir construction site. The Influent Tanks are interconnected with a pipe manifold; the levels in the Influent Tanks are expected to equalize. One ultrasonic level sensor (LIT-2020) is installed on Influent Tank TK-1B. Another ultrasonic level sensor (LIT-2021) is installed on Influent Tank TK-1C to serve as a backup level sensor. Operations are as follows:

- LIT-2020 (or LIT-2021 backup if LIT-2020 is not in service) will continuously measure the water level in the Influent Tanks TK-1A, 1B, 1C, 1D, and 1E. Operator-adjustable levels will include the following:
  - Low Level: Water level to turn OFF all PU-1A, 1B and 1C. Minimum water level in the tanks that will generate an alarm at the SMPS Control Panel and transmit it to the Master Control Panel to trigger an alarm callout.
  - Permissive Level One: Water level for two (lead/lag) Influent Pumps operation.
  - Permissive Level Two: Water level for all three (lead/lag/second lag) Influent Pumps operation.
  - High Level: An alarm is transmitted from the SMPS Control Panel to the Master Control Panel and then to the operator via the Auto-Dialer. The flow control valve XV-2010 shall close and an alarm shall be transmitted from the SMPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer. As the valve closes, the pressure in the transfer line from the weir construction site to the SMPS will increase. As the pressure increases the

pressure control valve installed on the bypass line at the Sunrise Mountain weir site will open diverting the water to the Las Vegas Wash. The operator will immediately contact the weir construction supervisor to alert them.
    - The tanks have overflow piping that directs any overflow to the ground right next to the tank, from where it will drain eventually into the sump on site.
- Once the level measured by LIT-2020 or LIT-2021 falls below a pre-set High level (9 ft.) for 5 minutes:
    - Flow Control Valve XV-2010 will OPEN to allow the flow to enter the Influent tanks TK-1A, 1B, 1C, 1D, and 1E. The operator must contact the SNWA contractor's supervisor and inform them that the control valve has been opened.
- Once the level measured by LIT-2020 or LIT-2021 falls below a pre-set Low level (2 ft.) for 2 minutes:
    - All the operating pumps at SMPS will STOP.
    - An alarm is generated by the SMPS Control Panel and transmitted to the Master Control Panel and trigger an alarm callout.

3.1.1.4 Discharge Pressure Safety Valve

A spring-loaded pressure safety valve (PSV) is installed at the discharge header of the pumps (PU-1A, 1B, and 1C) to provide minimal flow protection for the pumps. In the event there is an operational problem at the CWTP which causes the pressure in the transfer line from the SMPS station to rise close to the pump shutoff head, the pressure safety valve will open and return the water that meets the pump minimal flow requirement back to tank TK-1A. Operations are as follows:

- Once the pressure in the line flowing to CWTP exceeds a pre-set level (175 pounds per square inch gauge [psig]):
    - PSV-201 will OPEN to return the water that is equal to the pump's minimal flow requirement from the pump discharge header back to influent tank TK-1A at SMPS.
- Once the pressure falls below a pre-set level (175 psig):
    - PSV-201 will CLOSE to allow forward flow out of the Influent Tanks TK-1A, 1B, 1C, and 1D to the combined header to the CWTP.

3.1.2 Influent Pumps

Three variable-speed Influent Pumps (PU-1A, 1B, and 1C) are used to send water from Influent Tanks TK-1A, 1B, 1C, 1D, and 1E to the line transferring combined water to the Cyclone Separators (HC-1 and 2) at the CWTP through an 18-inch transmission line. A fourth pump is stored on site as a shelf spare. The pumps are controlled via level (as measured by LIT-2020 or LIT-2021) in the Influent Tanks TK-1A, 1B, 1C, 1D, and 1E, and the Master Control Panel that monitors the total number of operating pumps from both pump stations. The three Influent Pumps will operate in lead/lag/second lag mode. The configuration of pumps to be used as lead/lag/second lag and is cycled for every pump run. Operations are as follows:

- The following information for each of the Influent Pumps PU-1A, 1B, and 1C is monitored by the SMPS Control Panel and is transmitted to the Master Control Panel at the CWTP:
    - Number of pumps in operation;
    - Number of motor starts and stops; and
    - Motor runtimes.
- As the water level in the Influent Tanks TK-1A, 1B, 1C, 1D, and 1E rises, the pumps are turned ON as follows:
    - Level reaches Permissive Level One (4.2-ft.): Lead and Lag SMPS pumps are turned ON.

    - Level reaches Permissive Level Two (5.4-ft.): Lead and Lag pumps operating, and second lag pump is turned ON.
    - Level reaches High Level (6.5-ft.): An alarm is generated by the SMPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout.
- As the water level in the Influent Tanks TK-1A, 1B, 1C, 1D, and 1E starts to drop, the pumps are turned OFF in the following sequence:
    - Level reaches Permissive Level Three (3.5-ft.): Second lag pump, if operating, is turned OFF, and lead and lag pumps remain operating, if already started.
    - Level reaches Permissive Level Four (2.5-ft.): Lag and Lead pumps are turned OFF.
    - Level reaches the Low Level (1.5-ft.): An alarm is generated by the SMPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout.

It should be noted that the low and high level values as used here are typical values. Based on actual field conditions and flow rate these values may be changed by the operator.

3.2 HISTORIC LATERAL PUMP STATION

3.2.1 Groundwater Collection

Four 20,100-gallon Influent Tanks (TK-2A, 2B, 2C, and 2D) are provided at the HLPS to receive the groundwater generated from the Historic Lateral weir construction activities. The weir construction company is responsible for transferring the groundwater from the weir construction site to a pipeline located in the vicinity of the Influent Tanks at the HLPS. SNWA's contractor will install a by-pass line at their battery limits on the groundwater transfer line. Under emergency conditions, the by-pass line can return the untreated groundwater to the Las Vegas Wash instead of sending it to the pump station. The bypass line is equipped with a pressure relief valve which will open when the pressure in the transfer line is increased. Under emergency conditions when the control valve on the inlet line to the HLPS storage tanks is throttled down the pressure in the transfer line from the weir construction site will increase, thereby opening the pressure relief valve and diverting the water to the Las Vegas Wash. This will protect the transfer pump(s) at the weir site.

If the solids in the influent line to either pump station rise to 500 ppm or greater, the operator has the option of starting the polymer system at each pump station. The Influent Tanks are equipped with a discharge nozzle at the bottom of each tank. The nozzles are equipped with quick connects. Once per week, a hose connection will be used to remove the settled solids into a vacuum truck which will take solids off-site for disposal.

3.2.1.1 Influent Flow

One magnetic flow meter (FM-3010) and one electrically actuated flow control valve (XV-3010) are installed on the influent pipe to the Influent Tanks (TK-2A, 2B, 2C and 2D) at the HLPS. FM-3010 will provide instantaneous and totalized flow for the groundwater entering the Influent Tanks TK-2A, 2B, 2C, and 2D. XV-3010 will control flow entering the Influent Tanks and is normally OPEN. Operations are as follows:

- FM-3010 will measure instantaneous flow entering Influent Tanks TK-2A, 2B, 2C and 2D.
    - Instantaneous flow is sent to the HLPS Control Panel, where it is totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows and the lifetime flow will be recorded and kept for 730 days.
- The reading from FM-3010 at the HLPS is summed with the readings from flowmeter FM-2010 installed at SMPS to indicate the total flow fed to the two-pump station. The total flow is used by the control system to monitor and control water flow entering the Treatment Plant.

- When the instantaneous total flow rate measured by FM-3010 and/or FM-2010 exceeds a pre-set value of 6,900 gpm for 30 seconds:
  - If the flow measured by FM-3010 exceeds 6,900 gpm for 30 seconds, the flow through FM-2010 is checked and the Flow Control Valve XV-3010 is throttled down so that the combined flow does not exceed 6,900 gpm. If the flow combined flow measured by FM-2010 and FM-3010 exceeds 6,900 gpm for 30 seconds, the Flow Control Valve XV-3010 will be throttled down so that the total flow entering SMPS and HLPS does not exceed 6,900 gpm.
  - High-Flow Alarm is generated. The alarm is transmitted from the HLPS Control Panel to the Master Control Panel and then to the operator via the Auto-Dialer.
  - The Operator shall contact weir general contractor and inform them the flow has exceeded 6,900 gpm.

3.2.1.2 Influent Total Suspended Solids

One online real-time TSS monitor (AIT-3010) is installed on the feed line transferring groundwater from the Historic Lateral Weir construction site to the HLPS. AIT-3010 will provide instantaneous TSS readings of the water coming from the construction site. Under the automatic operational mode for TSS control, the SCADA system has been programmed to operate as follows. However, based on actual field conditions the operator may decide to operate the TSS control logic manually

- AIT-3010 will measure the instantaneous TSS concentration of groundwater being generated from the weir construction site.
  - Instantaneous TSS readings are sent to the HLPS Control Panel, and the Master Control Panel at CWTP. The TSS reading will be recorded and kept for 730 days.
- When the instantaneous TSS reading measured by AIT-3010 at HLPS exceeds 120 ppm for 5 minutes:
  - High-TSS Alarm is generated. The alarm is generated by the HLPS Control Panel and transmitted to the Master Control Panel and then to the operator via the Auto-Dialer.
  - Operator may decide to change the plant solids management operation mode.
- When the instantaneous TSS reading measured by AIT-3010 at HLPS exceeds 500 ppm for 5 minutes:
  - High TSS alarm shall be generated. The alarm shall be generated by the HLPS Control Panel and transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.
  - The polymer system CH-2 shall start and add polymer to the water line before entering the storage tanks.
  - If the TSS measured by AIT-3010 drops below 500 ppm for 5 minutes. The polymer system CH-2 shall stop.

3.2.1.3 Influent Tank Level Measurements

Four 20,100-gallon Influent Tanks (TK-2A, 2B, 2C, and 2D) are used to store groundwater that is generated from the Historic Lateral Weir construction site. The Influent Tanks are interconnected with a pipe manifold; the levels in the Influent Tanks are expected to equalize. One ultrasonic level sensor (LIT-3020) is installed on Influent Tank TK-2B. Another ultrasonic level sensor (LIT-3021) is installed on Influent Tank TK-2C to serve as a backup level sensor. Operations are as follows.

- LIT-3020 (or LIT-3021 backup if LIT-3020 is not in service) will continuously measure the water level in the Influent Tanks TK-2A, 2B, 2C, and 2D. Operator-adjustable levels shall include the following:

- Low Level: Minimum water level that will generate an alarm at the HLPS Control Panel and transmit to the Master Control Panel to trigger an alarm callout.
- Permissive Level One: Water level for two (lead/lag) Influent Pumps operation.
- Permissive Level Two: Water level for three (lead/lag/second lag) Influent Pumps operation.
- High Level: The flow control valve XV-3010 shall throttle down and an alarm shall be transmitted from the SMPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer. As the valve throttles down, the pressure in the transfer line from the weir construction site to the SMPS will increase. As the pressure increases the pressure control valve installed on the bypass line at the Sunrise Mountain weir site will open diverting the water to the Las Vegas Wash. The operator will immediately contact the weir construction supervisor to alert them.
- The tanks have overflow piping that directs any overflow to the ground right next to the tank, from where it will drain eventually into the sump on site.

- Once the level measured by LIT-3020 or LIT-3021 falls below a pre-set Low level (1.5 ft.) for 2 minutes:
  - All the operating pumps at HLPS will STOP.
  - An alarm is generated by the HLPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout.

3.2.1.4 Discharge Pressure Safety Valve

A spring-loaded Pressure Safety Valve is installed at the discharge header of the pumps (PU-2A, 2B, and 2C) to provide minimal flow protection for the pumps. In the event there is an operational problem at the CWTP which causes the pressure in the transfer line from the HLPS station to rise close to the pump shutoff head, the pressure safety valve will open and return the water that meets the pump minimal flow requirement back to tank TK-2A. Operations are as follows:

- Once the pressure in the line flowing to CWTP exceeds a pre-set level (225 psig):
  - PSV-301 shall OPEN to return the water that is equal to the pump's minimal flow requirement from the pump discharge header back to influent tank TK-2A at HLPS.
- Once the pressure falls below a pre-set level (225 psig):
  - PSV-301 shall CLOSE to allow forward flow out of the Influent Tanks TK-2A, 2B, 2C, 2D to the combined header to the CWTP.

3.2.2 Influent Pumps

Three variable-speed Influent Pumps (PU-2A, 2B and 2C) are used to send water from Influent Tanks TK-2A, 2B, 2C, and 2D to the line transferring combined water to the cyclone separators (HC-1 and 2) at the CWTP through an 18-inch transmission line. A fourth pump is stored on-site as a shelf spare. The pumps are controlled via level (as measured by LIT-3020 and LIT-3021) in the Influent Tanks TK-2A, 2B, 2C and 2D, and the Master Control Panel that monitors the total number of operating pumps from both pump stations. The three Influent Pumps shall operate in lead/lag/second lag mode. The configuration of pumps to be used as lead/lag/second lag and will be automatically cycled for each pump run. Operations are as follows:

- The following information for each of the Influent Pumps PU-2A, 2B and 2C is monitored by the HLPS Control Panel and is transmitted to the Master Control Panel at the CWTP:
  - Number of pumps in operation
  - Number of motor starts and stops
  - Motor runtimes

- As the water level in the Influent Tanks TK-2A, 2B, 2C and 2D rises, the pumps are turned ON as follows:
    - Level reaches Permissive Level One (4.7-ft.): Lead and Lag HLPS pump are turned ON
    - Level reaches Permissive Level Two (5.0-ft.): Lead and Lag HLPS pump operating, and second lag HLPS pump is turned ON
    - Level reaches High Level (6.5-ft.): An alarm is generated by the HLPS Control Panel transmitted to the Master Control Panel to trigger an alarm callout.
- As the water level in the Influent Tanks TK-2A, 2B, 2C and 2D starts to drop, the pumps are turned OFF in the following sequence:
    - Level reaches Permissive Level Three (2.7-ft.): Second lag pump, if operating, is turned OFF, and lead and lag pumps remain operating, if already started.
    - Level reaches Permissive Level Four (3-ft.): Lag and Lead pump are turned OFF.
    - Level reaches the Low Level (2-ft.): An alarm is generated by the HLPS Control Panel transmitted to the Master Control Panel to trigger an alarm callout.

It should be noted that the low and high level values as used here are typical values. Based on actual field conditions and flow rate these values may be changed by the operator.

3.3 CENTRAL WATER TREATMENT PLANT

3.3.1 Overall Flow Control and Solids Management

3.3.1.1 Overall Flow Control

Total flow coming from the two pump stations is limited to 6,900 gpm. Flow signals from the influent flowmeters FM-2010 (at SMPS) and FM-3010 (at HLPS) are sent to the Master Control Panel at the CWTP. Based on the flow rates measured by FM-2010 and FM-3010, the Master Control Panel will determine whether one of the flow control valves XV-2010 and XV-3010 will need to be closed and throttled down respectively.

- The Master Control Panel will continuously calculate the sum of the flow rate readings from FM-2010 and FM-3010, installed at the SMPS and HLPS, respectively.
- When the sum of the flow rates exceeds 6,900 gpm:
    - High-Flow Alarm is transmitted to the Master Control Panel and then to the operator via the Auto-Dialer.
    - The Flow Control Valve XV-3010 will be throttled down so that the total flow to SMPS and HLPS does not exceed 6,900 gpm.
    - The operator will contact SNWA's contractor and inform them the total flow has exceeded 6,900 gpm and inform them which control valve was throttled down.
- When the sum of the flow rates falls below 6,900 gpm for 5 minutes:
    - The flow control valve that had been throttled down will OPEN.
    - When the valve opens, the operator will call the weir operational staff to inform them that the valve has opened.

3.3.1.2 Overall Solids Management

The Treatment Plant is designed with different solids management strategies based on the TSS and perchlorate in the influent stream, Cyclone Waste, and Backwash Waste. Initially, the solids from the cyclone underflow will be sent to the Cyclone Waste Tank. As the Cyclone Waste Tank starts to get filled, the underflow will be directed directly to the Backwash Waste Tank. The waste in the Cyclone Waste Tank shall be slowly transferred to the Backwash Waste Tank. Based on the TSS and perchlorate concentrations in the cyclone underflow and backwash waste, the solids from the Backwash Waste Tank shall be blended with the effluent stream for discharge to the Las Vegas Wash. The operators shall perform mass balance calculations to determine the suitable blending rate to be within discharge limitations for TSS and perchlorate. If, after performing the mass balance calculations, the operators determine that the waste from the Backwash Waste Tank cannot be blended with the effluent, the waste shall be directed to holding tanks on site. The waste shall be stored in the holding tanks, where the solids are allowed to settle. After solids settling, the water shall de decanted and transferred to the SMPS Influent Tanks. Once per week or as necessary, a hose connection will be used to remove the settled solids into a vacuum truck which will take solids off-site for disposal.

If the TSS in the combined stream exceeds 120 ppm, the operator will switch manual valves to direct the underflow from the cyclones to the Cyclone Waste Tank (TK-5). The solids are stored in this tank and, if operations allow, are intermittently transferred to the Backwash Waste Tanks (TK-3A and 3B). From the Backwash Waste Tanks, the solids are blended into the discharge line at a given rate based on mass balance to ensure the TSS in the effluent stream is less than discharge limit of 135 ppm. In the event operations do not allow blending these solids with the discharge stream, they will be removed with a vacuum truck for off-site disposal. For all blending operations, the operator must closely monitor the TSS concentration in the treated water being discharged to the Las Vegas Wash to make sure the TSS in the discharge stays below the discharge limit of 135 ppm. As noted previously, groundwater containing more than 500 ppm TSS from either weir may be chemically treated with polymer before entering the Influent Tanks. While the cyclones can handle potentially higher than 500 ppm TSS by allowing a larger underflow flow rate, an underflow rate higher than 10 gpm will cause a potential for exceedance of the perchlorate limit in the discharge stream.

3.3.2 Cyclone Separators

The cyclones are designed to remove approximately 90 percent of solids equal to or greater than 10 microns in size. As water flows through the cyclone separators, a large fraction of the water containing a small quantity of solids leaves the cyclone as the overflow while a small quantity of liquid containing a large quantity of solids leave the cyclone as underflow. The underflow contains solids with specific gravity equal to or greater than approximately 2 g/cc. The hydraulic design capacity of the cyclones is 6,900 gpm.

3.3.2.1 Underflow Management Strategy

The cyclones are designed with two underflow orifice openings, which control the solid concentration in the underflow stream. If the solid concentration in the underflow stream becomes too high, the underflow pipe may become plugged and cause disruption in the operation of the cyclones. The first assembly is equipped with smaller orifices designed to handle groundwater containing TSS less than 400 ppm, and is limited to an underflow flow rate of approximately 10 gpm. The second discharge assembly at the cyclone underflow is equipped with larger orifices designed to handle groundwater containing TSS greater 400 ppm, and is limited to an underflow flow rate of 20-100 gpm. The operators shall open the correct orifice based on the following:

- 160-400ppm: Small orifice (15 gpm)
- 400-1,000ppm: Large orifice, partially open (20 gpm)
- 1,000-2,000ppm: Large orifice, partially open (30 gpm)
- 2,000-4,000ppm: Large orifice, partially open (70 gpm)
- 4,000-5,000ppm: Large orifice, partially open (90 gpm)
- 5,000+ ppm: Large orifice, fully open (100 gpm)

An online real-time TSS monitor is installed on the feed line to the cyclones (AIT-4010) and provides instantaneous TSS readings. AIT-4010 provides the TSS data upon which cyclone underflow management strategy described above is determined. The control system will continuously evaluate the TSS concentration in the combined stream going to the cyclones.

Table 2 summarizes the simulations that were run by FL Smidth to show the removal efficiency of cyclones at different TSS concentrations in groundwater and the underflow and overflow flow rates. The table shows the flow rate and TSS concentrations in the feed, cyclone overflow, and underflow streams.

Table 2 Simulation Results for Cyclones

Flow (gpm)			Orifice Size	TSS		
Feed	Overflow	Underflow		Feed (ppm)	Overflow (ppm)	Underflow (Vol % solids)
6,900	6,890	10	Small	250	6	17
6,900	6,890	10	Small	500	11	34
6,900	6,890	10	Small	600	13	41
6,900	6,862	38	Large	500	11	9
6,900	6,862	38	Large	1,000	22	18
6,900	6,862	38	Large	2,000	45	36

There are two important parameters to watch in evaluating the performance of the cyclones: 1) the underflow flow rate and 2) the solids concentration in the underflow. The significance of the underflow flow rate is the fact that the underflow will ultimately be blended with the treated water before discharge to the Las Vegas Wash. As the cyclone operation does not reduce perchlorate concentration in the underflow and the underflow will not undergo any additional treatment, this stream will contain perchlorate equivalent to the perchlorate in the feed water. If blended with treated water for discharge, this stream will contribute perchlorate and TSS to the treated water. Example calculations showing the effects of blending are provided in Section 3.3.9.3.

3.3.2.2 Cyclone System Feed

One magnetic flow meter (FM-4010) is installed on the common feed pipe to the two cyclone vessels (HC-1 and 2) at the CWTP. FM-4010 provides instantaneous and totalized flow of water entering the cyclones. Operations are as follows:

- FM-4010 measures instantaneous flow entering cyclones HC-1 and 2.
    - Instantaneous flow are sent to the Master Control Panel, where it is totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
- When the instantaneous flow rate measured by FM-4010 exceeds 6,900 gpm:
    - High-Flow Alarm shall be transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.
    - The Operator shall contact weir general contractor and inform them the total flow has exceeded 6,900 gpm; the weir contractor may suggest which control valve should be closed or throttled down to reduce the total flow to below 6,900 gpm at his preferred weir.

- In the event weir contractor representative is not available, the Master Control Panel shall identify the pump station (either of SMPS or HLPS) with lower flowrate reading by comparing the influent flowrate readings from FM-2010 (at SMPS) and FM-3010 (at HLPS).
- The Master Control Panel shall command to close the respective flow control valve (either XV-2010 for SMPS or XV-3010 for HLPS) at the pump station with lower incoming flow to reduce the total flow feed to CWTP.

- When the sum of the flowrates falls below 6,900 gpm for 5 minutes:
  - The flow control valve (either XV-2010 or XV-3010) that had been closed or throttled down shall OPEN.

One electrically actuated on/off valve (XV-4010) is installed on the common feed pipe to the two cyclone vessels (HC-1 and 2) at the CWTP to provide quick plant shut-down in emergency situations by the operator. Operations of the electrically actuated on/off valve (XV-4010) are as follows:

- Valve XV-4010 is opened or closed by a push button on the Master Control Panel at CWTP.
- When XV-4010 is closed:
  - Any operating Influent Pumps (PU-1A, 1B, 1C and PU-2A, 2B, 2C) at both SMPS and HLPS will also be shut down by interlocks.

3.3.2.3 Cyclone Vessel Operation

The cyclone system consists of two separate cyclone vessels (HC-1 and 2). Each cyclone vessel has three chambers containing a total of 120 operating cyclones in each vessel, and each cyclone is 2 inches in diameter. Depending on the groundwater flow rate, the system can operate with only a single chamber within a single vessel or it can operate with all six chambers in both vessels. At the design flow rate of 6,900 gpm, all six chambers will be operating. ***Table 3*** lists all chambers and the number of 2-inch cyclones in each chamber.

Table 3 Number of Operating Cyclones per Chamber

Chamber Number	Number of Operating Cyclones
Cyclone Vessel #1	
Chamber 1A	20
Chamber 1B	40
Chamber 1C	60
Cyclone Vessel #2	
Chamber 2A	15
Chamber 2B	44
Chamber 2C	61

Each chamber will have one motor-operated valve on the inlet line and one motor-operated valve on the overflow line, for a total of 12 motor-operated valves (XV-502, 505, 508, 511, 514, and 517 for HC-1; XV-522, 525, 528, 531, 534, and 537 for HC-2). The valves are open-close valves controlled by the Master Control Panel based on the pressure drop across the cyclone vessels to accomodate feed flow variation while maintaining the treatment efficiency. The relationship between the solids removal by the cyclones at different flow rates and the number of operating cyclone units within different chambers, with corresponding system presure drops, is shown ***Table 4*** below.

Table 4 Cyclone Vessel Operation based on Hydraulic Capacity

Minimum Flow Rate (gpm)	Maximum Flow Rate (gpm)	Number of Operating Cyclones	Operating Chambers	Expected Approximate Pressure Drop (psig)
0	2,500	80	1A; 1C	53
2,500	3,000	120	2A; 2B; 2C	53
3,000	3,700	140	1A; 2A; 2B; 2C	53
3,700	4,785	180	1A; 1B; 2A; 2B; 2C	53
4,785	6,899	225	1A; 1B; 1C; 2B; 2C	53
6,899	>6,900	240	1A; 1B; 1C; 2A; 2B; 2C	53

Each cyclone vessel will have one pressure safety valve (PSV-501 for HC-1 and PSV-521 for HC-2) to protect the units from excess pressure. Cyclone units use pressure energy from the flow stream to achieve separation of solids. Liquid with solids enter the cyclone liner tangentially through the inlet. The change in flow direction forces the mixture to spin in a radial vortex pattern. This vortex flow is accelerated as the internal diameter is reduced over the length of the cone. Due to the angular acceleration of the flow pattern, centrifugal forces are imparted on the solid particles forcing them toward the wall of the cone. The solids continue to spin in a radial vortex motion, down the length of the cone, to discharge through the apex to create the underflow (waste) stream. The cone convergence causes the remaining liquid flow to reverse, which is sent upward through the vortex to create the overflow (clean) stream.

The underflow is sent either to the Cyclone Waste Tank (TK-5) via valve KGV-801 or the Backwash Waste Tanks (TK-3A and 3B) via valve KGV-803, as selected by the operator. The overflow will enter the Multi-Media Filters (MMF-1A/B through 3A/B).

Differential Pressure Measurement (PIT-5010A and PIT-5010B)

Two pressure sensors (PIT-5010A and PIT-5010B) are installed at the cyclone vessel feed header and overflow header, respectively. The pressure readings from the two pressure sensors are transmitted to the Master Control Panel to determine the differential pressure across the cyclone units. The pressure difference between the influent and effluent lines controls the cyclone operation.

- The cyclone separators are operated with the differential pressure across the system between 40 psi and 55 psi, and performs best at about 54 psi.

3.3.2.4 Cyclone Waste Tank

The Cyclone Waste Tank (TK-5) is a 20,160-gallon Baker-style tank that will receive the underflow waste from the cyclones. The tank is equipped with four vertical-shaft mixers (MX-2A, 2B, 2C, and 2D). The operating speed of the mixer is 70-rpm. Each mixer is equipped with individual 10-hp motor, motor controllers and circuit protection.

During normal option, when the TSS concentration in the feed stream is below 120 ppm, the cyclone underflow waste is sent to the Backwash Waste Tanks (TK-3A, 3B). However, if the TSS concentration in the cyclone influent rises above 120 ppm, the operator will manually close the valve to the Backwash Waste Tank and open the valve to direct the high TSS content underflow waste to the Cyclone Waste Tank (TK-5). If operations allow, the solids are intermittently transferred to the Backwash Waste Tanks (TK-3A and 3B). From the Backwash Waste Tanks, the solids are blended into the discharge line at a given rate based on mass balance to ensure the TSS in the effluent stream is less than discharge limit of 135 ppm. In the event operations do not allow blending these solids with the discharge stream, they will be removed with a vacuum truck for off-site disposal.

Level Measurement

One ultrasonic Level Sensor (LIT-8020) is installed on the Cyclone Waste Tank (TK-5). Another ultrasonic level sensor (LIT-8021) is installed on the Cyclone Waste Tank (TK-5) to serve as a backup level sensor. Operations are as follows:

- LIT-8020 (or LIT-8021 backup if LIT-8020 is not in service) continuously measures the waste level in the Cyclone Waste Tank (TK-5). Operator-adjustable levels include the following:
    - Low Level: An alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout. Backup signal will be sent to turn OFF all Cyclone Waste Pumps PU-4A/4B.
    - Duty pump OFF: Duty pump is turned OFF.
    - Standby pump OFF: Standby pump is turned OFF.
    - Mixer Level: Waste level for operation of the mixers MX-2A, 2B, 2C, and 2D; this is equal to the required minimum submergence.
    - Duty Pump ON: Waste level for one (duty) pump operation.
    - High Level: Waste level for two (duty/standby) pumps operation.
    - High-High Level: Maximum waste level to provide an alarm to the operator.
- When the level measured by LIT-8020 drops below a pre-set Mixer level (2 ft.):
    - Mixers MX-2A, 2B, 2C, and 2D are turned OFF.
- When the level measured by LIT-8020 rises above a pre-set Mixer level (3 ft.):
    - Mixers MX-2A, 2B, 2C, and 2D are turned ON.
- When the level measured by LIT-8020 rises above a pre-set high-high level (6.5 ft.):
    - High-High Level Alarm is generated. The alarm is transmitted to the Master Control Panel and then to the operator via the Auto-Dialer.

3.3.2.5 Cyclone Waste Pumps

Two variable-speed progressing-cavity Cyclone Waste Pumps (PU-4A and 4B) are used to pump the underflow waste from the Cyclone Waste Tank (TK-5) to the Backwash Waste Tanks (TK-3A/B). Alternatively, the operator can switch valve positions on the line leaving the Cyclone Waste Tank (TK-5) to pump the underflow waste from the Cyclone Waste Tank (TK-5) to a vacuum truck for off-site disposal. The off-site disposal of solids is considered when TSS concentration in the feed stream is high and the solids cannot be blended in the treated effluent. The cyclone pumps are controlled via level (as measured by LIT-8020) in the Cyclone Waste Tank (TK-

5). The two pumps will operate based on duty/standby mode. The configuration of pumps to be used as duty/standby will be manually cycled once a week by the operator. Operations are as follows:

- The following information for each of the Cyclone Waste Pumps (PU-4A and 4B) is monitored by the Master Control Panel:
  - Number of motor starts and stops.
  - Motor runtimes.
- As the water level in the Cyclone Waste Tank (TK-5) rises, the pumps are turned ON as follows:
  - Duty Pump ON: Duty pump is turned ON.
  - High Level: Duty pump operating, and standby pump is turned ON.
  - High-High Alarm: Alarm is transmitted to Master Control Panel to trigger an alarm callout.
- As the water level in the Cyclone Waste Tank (TK-5) drops, the pumps are turned OFF as follows:
  - Standby OFF: Duty pump operating, and standby pump is turned OFF.
  - Duty OFF: Duty pump is turned OFF.
  - Low Level: Alarm is transmitted to Master Control Panel to trigger an alarm callout. Backup signal will be sent to turn OFF all pumps.

Truck Connection

When required, the Cyclone Waste Pumps (PU-4A and 4B) are used to pump the underflow waste out of the Cyclone Waste Tank (TK-5) to a vacuum truck to be hauled off-site, and this is conducted manually by the operator. One quick connection with valve KGV-820 is provided on the discharge line from Cyclone Waste Pumps (PU-4A and 4B).

Underflow Waste Flow

One magnetic flow meter (FM-8040) is installed on the common discharge pipe of the Cyclone Waste Pumps (PU-4A and 4B). FM-8040 provides instantaneous and totalized flow for the waste entering the Backwash Waste Tanks (TK-3A/B) or pumped into a truck for off-site disposal. Operations are as follows:

- FM-8040 will measure instantaneous and totalized flow entering Backwash Waste Tanks (TK-3A/B).
  - Instantaneous flow is sent to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the Backwash Waste Tank. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

3.3.2.6 Guidelines for Operators

The operators should follow the guidelines below to optimize the cyclone performance:

1. At low TSS concentrations use smaller underflow orifice size as much as possible to keep underflow flow rate at around 10 gpm.
2. Monitor the solids concentration in the underflow stream to ensure the underflow pipe is not plugged. If the TSS concentration in cyclone overflow rises above 500 ppm, start the polymer system at the CWTP.
3. If solids concentration in the feed water rises above 400 ppm, switch the underflow orifice to the larger orifice. The underflow flow rate should be increased from 30 gpm to 100 gpm as the TSS concentration in the influent water rises from 400 ppm to 5000 ppm.
4. Routinely calculate the contribution from underflow stream to treated water perchlorate concentration.

3.3.3 CWTP Coagulant and Polymer Addition

Depending on the TSS concentration, ferric chloride can be added to influent wastewater leaving the SMPS to coagulate solids contained in the influent stream. A metering pump is used to add 10 ppm ferric chloride from a tote to the influent water leaving the SMPS. As soon as the ferric chloride pump is turned on the operator should also turn the polymer pump on. Ferric chloride used as coagulant improves the effectiveness of the polymer in removing colloidal solids from water. Tests have shown that 10 mg/L ferric chloride is effective in coagulating TSS at concentrations as high as 3,000 mg/L. Tests have also indicated that at TSS concentration greater than 500 mg/L polymer alone may be used to remove solids contained in the cyclone overflow stream. At TSS concentration lower than 500 mg/L, using ferric chloride as coagulant significantly improves the effectiveness of polymer in removing TSS. Even at TSS concentration above 500 mg/L ferric chloride improves the TSS removal efficiency with polymer. Therefore, it is recommended that when TSS concentration in the cyclone overflow exceeds the NPDES Limit of 135 for TSS, ferric chloride be added to water leaving SMPS at 10 mg/L to improve TSS removal efficiency of the multi-media filters. It has been estimated that the residual iron in the treated water that is discharged to Las Vegas Wash may range from 1 to 2 mg/L iron. The polymer is fed to the MMF influent stream and the concentration of polymer being added depends on the plant influent flow and the TSS concentration. Polymer from the Polymer tote (TK-11) is pumped into the influent water stream by a polymer pump. In addition to the polymer pump, the polymer system also has a booster pump to dilute the neat polymer with water. The booster pump gets its feed water from a potable water tank. As pumping neat polymer into the influent stream can be counter-productive, the controls of the polymer system have been set to only run when the booster pump is running. Therefore, the operators should monitor the water level in the potable water tank to ensure smooth operation of the polymer system. It should be noted that both ferric chloride and polymer should only be added to water when there is flow in the pipeline.

3.3.4 Multi-Media Filters

Three horizontal Multi-Media Filters (MMF-1A/B, 2A/B, and 3A/B) are provided to remove residual solids leaving the cyclone separators. Each filter vessel consists of two filter cells, for a total of six cells. The filter cells are operated in parallel. The Multi-Media Filter system is designed with a hydraulic capacity of 6,900 gpm and TSS capacity of 40 ppm. Polymer is added to the water before it enters the filter system to improve the solids removal efficiency. An online TSS meter at the influent to and effluent from the Multi-Media Filter system is used to monitor the TSS concentration in the influent and effluent streams. Filtered water will then be transferred to the Ion Exchange System.

3.3.4.1 Pressure Regulation

A Pressure Regulator (PRV-601) is installed on the multimedia filter influent header. The regulator is used to ensure that the downstream pressure stays within the 80 to 90 psig range.

3.3.4.2 Total Suspended Solids

An online TSS Analyzer (AIT-6010) is installed to monitor the TSS concentration in the influent to the Multi-Media Filters system. When the TSS reading from AIT-6010 exceeds a pre-set value, an alarm is generated by the Master Control Panel and trigger an alarm callout.

3.3.4.3 Influent Flow

Each filter vessel is equipped with a magnetic flow meter (FM-6010, FM-6020 and FM-6030, for MMF-1A/B, MMF-2A/B and MMF-3A/B, respectively) and an electrically actuated modulating flow control valves (FV-6010, FV-6020 and FV-6030, for MMF-1A/B, MMF-2A/B and MMF-3A/B, respectively). The flowmeters (FM-6010, FM-6020 and FM-6030) will provide instantaneous and totalized flow entering each filter vessel. The flow meter valves are used to modulate the flow control valves (FV-6010, FV-6020 and FV-6030) so that the total flow is evenly distributed between the three filter vessels. The local programmable logic controller (PLC) will control all aspects of the Multi-Media Filters system and it will communicate with plant Master Control Panel for monitoring purposes. Operations are as follows:

- FM-6010 will measure instantaneous flow entering Multi-Media Filters MMF-1A/B.
  - Instantaneous flow rate is transmitted to the Filter Control Panel and then to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the filter vessels. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
  - The flow rate reading is compared with that from the other two flowmeters (FM-6020 and FM-6030) by the Filter Control Panel.
  - Flow Control Valve FV-6010 will modulate until the flow rate reading from Flowmeter FM-6010 is the same as those from the other two flowmeters (FM-6020 and FM-6030).
- FM-6020 will measure instantaneous flow entering Multi-Media Filters MMF-2A/B.
  - Instantaneous flow rate is transmitted to the Filter Control Panel and then to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the filter vessels. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
  - The flow rate reading is compared with those from the other two flowmeters (FM-6010 and FM-6030) by the Filter Control Panel.
  - Flow Control Valve FV-6020 will modulate until the flow rate reading from Flowmeter FM-6020 is the same as those from the other two flowmeters (FM-6010 and FM-6030).
- FM-6030 will measure instantaneous flow entering Multi-Media Filters MMF-3A/B.
  - Instantaneous flow rate is transmitted to the Filter Control Panel and then to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the filter vessels. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
  - The flow rate reading is compared with those from the other two flowmeters (FM-6010 and FM-6020) by the Filter Control Panel.
  - Flow Control Valve FV-6030 will modulate until the flow rate reading from Flowmeter FM-6030 is the same as those from the other two flowmeters (FM-6010 and FM-6020).

3.3.4.4 Control Valves

Each Multi-Media Filter cell has eight electrically actuated control valves, for a total of 48 valves. The valves are open-close valves and they are operated by the Filter Control Panel. The valves for each filter cell will include:

- One influent feed valve
- One filtered water valve
- One rinse water inlet valve
- One rinse water discharge valve
- One backwash inlet valve
- One backwash waste valve
- One air scouring drain valve
- One air scouring valve

Table 5 below shows the control valve designations for each Multi-Media Filters cell:

Table 5 Valve Designations for Multi-Media Filters Cells

MMF Cell No.	Influent Feed Valve	Filtered Effluent Valve	Rinse Water Inlet Valve	Rinse Water Discharge Valve	Backwash Inlet Valve	Backwash Waste Valve	Air Scour Valve	Air Scour Drain Valve
1A	XV-601	XV-602	XV-603	XV-604	XV-605	XV-606	XV-607	XV-608
1B	XV-611	XV-612	XV-613	XV-614	XV-615	XV-616	XV-617	XV-618
2A	XV-621	XV-622	XV-623	XV-624	XV-625	XV-626	XV-627	XV-628
2B	XV-631	XV-632	XV-633	XV-634	XV-635	XV-636	XV-637	XV-638
3A	XV-641	XV-642	XV-643	XV-644	XV-645	XV-646	XV-647	XV-648
3B	XV-651	XV-652	XV-653	XV-654	XV-655	XV-656	XV-657	XV-658

3.3.4.5 Differential Pressure Measurement

Six pressure sensors (PIT-6010/6011, PIT-6020/6021 and PIT-6030/6031) are installed on the feed and effluent lines of each Multi-Media Filters (MMF-1A/B, 2A/B and 3A/B) to measure the pressure difference across the filters. As solids accumulate in the filters the pressure drop across the filter beds increases. The pressure difference between the inlet and outlet of each vessel can be used to determine when the filters need to be backwashed. Production time may also be used to schedule backwashes in the filters. The TSS concentration in the backwash waste stream is an important parameter to be considered when determining the frequency of the backwashes. A high TSS concentration of 500 ppm or greater in the backwash waste stream indicates that the filter media still contains solids and requires further backwashing. In this case, based on the operational parameters, the operational staff may choose to backwash more frequently. A TSS concentration of less than 500 ppm in the backwash waste stream indicates that the filter media is relatively clean and the operational staff may choose to reduce the backwash frequency. When using pressure drop for backwashing filter media, the operations follow the following procedure:

- PIT-6010 and PIT-6011 will continuously measure the pressure at the feed and effluent line, respectively, across Multi-Media Filters vessel MMF-1A/B.
- PIT-6020 and PIT-6021 will continuously measure the pressure at the feed and effluent line, respectively, across Multi-Media Filters vessel MMF-2A/B.
- PIT-6030 and PIT-6031 will continuously measure the pressure at the feed and effluent line, respectively, across Multi-Media Filters vessel MMF-3A/B.
- When the pressure drop measured by PIT-6010/6011, PIT-6020/6021 or PIT-6030/6031 rises above a pre-set level (15 psi), and the liquid levels in the Backwash Waste Tanks (TK-3A/B) and Filter Rinse Water Transfer Tank (TK-6) are both lower than respective Permissive Levels One, then:
    - The Multi-Media Filters Control Panel will start the rinsing and backwashing procedures for filter vessels that have shown the pressure drop increase. Multi-Media Filters Rinse/Backwash Procedures are described in Section 3.3.4.6.

3.3.4.6 Rinse/Backwash Procedures

When the pressure drop across a filter vessel rises to a pre-set valve, the two cells in the vessel have to be backwashed. However, before backwash, each cell has to be rinsed. The rinsing is necessary to displace the water in the cells which is contaminated with perchlorate. The contaminated rinse water must be treated to remove perchlorate.

The Filter Control Panel will only rinse and backwash one filter vessel cell at a time. A timer is used to prevent rinsing/backwashing any given filter cell more than twice per day. Additionally, only one cell can be rinsed/backwashed at a given time. The filter cell backwash can either be initiated by pressure drop across the filter vessels or by a timer based on a specified time interval between rinses and backwashes. All filter cells have to be backwashed once before any of the cells are backwashed a second time. Rinse and backwash operations are as follows:

- The Filter Control Panel starts the rinsing/backwashing operation on a filter cell by CLOSING the respective influent feed and filtered water effluent valves to stop forward flow from entering the filter cell to be backwashed. Refer to ***Table 5*** above for valve designations.
- The air scouring drain valve then OPENS to allow the water in the cell to be drained by gravity to a level just above the filter media, then the valve closes. The drainage flows to the Rinse Water Transfer Tank (TK-6). Refer to ***Table 5*** above for valve designations.
- Rinse water inlet and discharge valves OPEN, and then two Filter Rinse/Backwash Pumps (two of PU-5A, 5B, or 5C) are turned ON to rinse the filter cell for about 3 minutes. The rinse water leaving the filter cell flows to the Rinse Water Transfer Tank (TK-6). Once finished, the rinse water inlet and discharge valves CLOSE and operating Filter Rinse/Backwash Pumps are turned OFF. Refer to ***Table 5*** above for valve designations.
- Air scouring and air scouring drain valves OPEN, then the air scouring blower (BL-1A/B) is turned on and operates for 3-5 minutes. Air scouring is used to disengage the solid particles from the media. Once finished, the two valves CLOSE. Refer to ***Table 5*** above for valve designations.
- Backwash inlet and backwash waste valves OPEN, then two Filter Rinse/Backwash Pumps (two of PU-5A, 5B, or 5C) are turned ON to backwash the filter cell for 12 minutes. The spent backwash waste flows to one of the Backwash Waste Tanks (TK-3A or 3B). Once finished, the two valves CLOSE, and operating Filter Rinse/Backwash Pumps are turned OFF. Refer to ***Table 5*** above for valve designations.
- After backwash is complete, the influent feed valve and filtered water effluent valve OPEN. The filter cell is returned to normal operation. Refer to ***Table 5*** above for valve designations.

Backwash Water Flow

Three magnetic flow meters (FM-6011, FM-6021 and FM-6031) are installed on the individual backwash inlet headers entering each Multi-Media Filters vessel (MMF-1A/B, 2A/B, 3A/B). The flowmeters will provide instantaneous and totalized flows for water used for backwashing each filter vessel. Operations are as follows:

- FM-6011 will measure instantaneous backwash flow entering Multi-Media Filters Skid MMF-1A/B.
  - Instantaneous flow is transmitted to the Filter Control Panel and then to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the filter vessels. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
- FM-6021 will measure instantaneous backwash flow entering Multi-Media Filters Skid MMF-2A/B.
  - Instantaneous flow is transmitted to the Filter Control Panel and then to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily)

and over the operating lifetime of the filter vessels. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

- FM-6031 will measure instantaneous backwash flow entering Multi-Media Filters Skid MMF-3A/B.
    - Instantaneous flow is transmitted to the Filter Control Panel and then to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the filter vessels. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

3.3.5 Backwash Waste Tanks

The Backwash Waste Tanks (TK-3A and 3B) are 20,160-gallon Baker-style tanks that receive the backwash waste from the Multi-Media Filters. Each tank is equipped with four vertical-shaft mixers (MX-1A, 1B, 1C, 1D, and 1E for TK-3A, and MX-1E, 1F, 1G, and 1H for TK-3B). The operating speed of the mixers is 70-rpm. Each mixer is equipped with individual 10-hp motor, motor controllers and circuit protection.

3.3.5.1 Level Measurement

The Backwash Waste Tanks are interconnected with a pipe manifold; therefore, the levels in the Backwash Waste Tanks are expected to equalize. One ultrasonic Level Sensor (LIT-8030) is installed in Backwash Waste Tank TK-3B. Another ultrasonic level sensor (LIT-8031) is installed on Backwash Tank TK-3A to serve as a backup level sensor. Operations are as follows.

- LIT-8030 (or LIT-8031 backup if LIT-8030 is not in service) continuously measures the waste level in the Backwash Waste Tanks (TK-3A/B). Operator-adjustable levels will include the following:
    - Low-Low Level: An alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout. A backup signal will be sent to turn OFF all Backwash Waste pumps.
    - Low Level: Minimum waste level to turn OFF all Backwash Waste Pumps PU-3A, 3B and 3C.
    - Permissive Level One: Waste level for one (lead) pump operation; allows a filter rinse/backwash cycle to commence.
    - Mixer Level: Waste level for operation of the mixers MX-1A/E, 1B/F, 1C/G, 1D and 1E/H; this is equal to the required minimum submergence.
    - Permissive Level Two: Waste level for two (lead/lag) pumps operation. If there is a fault on the lag pump (i.e., pump will not turn ON when commanded), an alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout for Operator to manually turn ON the standby pump.
    - High Level: Waste level for all three (lead/lag/standby) pumps operation.
    - High-High Level: An alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout.
- When the level measured by LIT-8030 or LIT-8031 drops below a pre-set Mixer level (4 ft.):
    - Mixers MX-1A/E, 1B/F, 1C/G, 1D, and 1E/H is turned OFF.
- When the level measured by LIT-8030 or LIT-8031 rises above a pre-set Mixer level (5 ft.):
    - Mixers MX-1A/E, 1B/F, 1C/G, 1D, and 1E/H is turned ON.

3.3.5.2 Backwash Waste Pumps and Flow

Three variable-speed centrifugal (PU-3A, PU-3B, and PU-3C) are used to pump backwash waste from Backwash Waste Tanks (TK-3A and 3B) directly to the effluent line downstream of Effluent Pump PU-6D. The pumping rate is controlled based on the reading from the online TSS sensor AIT-8060 to ensure that the TSS reading from

AIT-8060 will not exceed the 135-ppm limit on TSS. The three pumps will operate based on lead/lag/standby mode, and will be manually cycled once a month by the operator. The pump start/stop control is based on the level (as measured by LIT-8030 or LIT-8031) in the Backwash Waste Tanks (TK-3A/B). The pumping flow rate is also monitored by the Flowmeter FM-8045. Operations are as follows:

- The following information for each of the Backwash Waste Pumps PU-3A, PU-3B, and PU-3C is monitored by the Master Control Panel:
  - Number of motor starts and stops
  - Motor runtimes
- As the water level in the Backwash Waste Tanks (TK-3A/B) rises, and any of the Treated Water Pumps (PU-6A/B/C/D) is in operation, the Backwash Waste Pumps are turned ON as follows:
  - Level reaches Permissive Level One: Lead pump is ON.
  - Level reaches Permissive Level Two: Lead pump operating, and lag pump is turned ON. If lag pump does not turn ON when commanded by the control system, then an alarm is transmitted to Master Control Panel to trigger an alarm callout for operator to manually turn ON the standby pump.
  - Level reaches High Level: Lead and lag pumps are operating, and the standby pump is turned ON.
  - Level reaches High-High Level: Alarm is transmitted to Master Control Panel to trigger an alarm callout.
- As the water level in the Backwash Waste Tanks (TK-3A/B) drops, the pumps are turned OFF as follows:
  - Level drops below Standby OFF: The standby pump, if operating, is turned OFF.
  - Level drops below Lag OFF: Lag pump, if operating, is turned OFF and lead pump remains operating.
  - Level drops below Low Level: Lead Pump OFF.
  - Level drops below Low-Low Level: Alarm is transmitted to Master Control Panel to trigger an alarm callout. Backup signal will be sent to turn OFF backwash waste pumps.
- FM-8045 will measure instantaneous flow from PU-3A, 3B and 3C.
  - Instantaneous flow rate is transmitted to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pumps. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

3.3.6 Filter Rinse Water Transfer Tank

The Filter Rinse Water Transfer Tank (TK-6) is a 20,100-gallon Baker-style tank that receives the rinse water from the Multi-Media Filters at the initial stage of the filter rinse/backwash cycle.

3.3.6.1 Level Measurement

One ultrasonic level sensor (LIT-8060) is installed on the Filter Rinse Water Transfer Tank (TK-6). Another ultrasonic level sensor (LIT-8061) is installed on Filter Rinse Water Tank (TK-6) to serve as a backup level sensor. Operations are as follows:

- LIT-8060 (or LIT-8061 backup if LIT-8060 is not in service) will continuously measure the water level in the Filter Rinse Water Transfer Tank (TK-6). Operator-adjustable levels will include the following:

- Low-Low Level: An alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout.
- Low Level: Minimum water level to turn OFF Filter Rinse Water Transfer Pumps (PU-7A and PU-7B).
- Permissive Level One: Water level for one (duty) pump operation; allows a filter rinse/backwash cycle to commence.
- High Level: Water level for two (duty/standby) pumps operation.
- High-High Level: An alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout.
- The tanks have overflow piping that directs any overflow to the ground right next to the tank, from where it will drain eventually into the sump on site.

3.3.6.2 Filter Rinse Water Transfer Pumps and Flow

Two constant-speed centrifugal pumps (PU-7A and PU-7B) are used to transfer rinse water from the Filter Rinse Water Transfer Tank (TK-6A) to the Ion Exchange System. The two pumps will operate under duty/standby mode. The configuration of pumps to be used as duty/standby will be manually cycled once a week by the operator. Operations are as follows:

- The following information for the Rinse Water Transfer Pumps PU-7A and PU-7B is monitored by the Master Control Panel:
  - Number of motor starts and stops.
  - Motor runtimes.
- As the water level in the Filter Rinse Water Transfer Tank TK-6 rises, the Rinse Water Transfer Pumps is turned ON as follows:
  - Permissive Level One: Duty pump ON.
  - High Level: Duty pump operating, and the standby pump is turned ON.
  - High-High Level: Alarm is transmitted to Master Control Panel to trigger an alarm callout.
- As the water level in the Filter Rinse Water Transfer Tank (TK-6) drops, the pumps are turned OFF as follows:
  - Level drops below Standby OFF: The standby pump, if operating, is turned OFF.
  - Level drops below Low Level: Duty Pump OFF.
  - Level drops below Low-Low Level: an alarm is transmitted to Master Control Panel and trigger an alarm callout. Backup signal shall be sent to turn OFF all rinse transfer pumps.
- FM-8065 will measure instantaneous flow from PU-7A and 7B.
  - Instantaneous flow rate is transmitted to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

3.3.7 Ion Exchange System

The Ion Exchange System has been designed around the removal of perchlorate; however, some nitrate and sulfate will also be removed by the Ion Exchange System. After a certain number of bed volumes (the exact number of bed volumes contingent on water quality characteristics of the water being treated), the ion exchange resin is expected to be loaded with nitrate and sulfate before the ion exchange resin will be loaded with perchlorate. As the ion exchange resin change-out is scheduled based upon perchlorate load, the Ion Exchange

System will stop removing nitrate and sulfate parameters from the groundwater after the resin is fully loaded with these constituents.

The Ion Exchange System consists of three ion exchange skid-mounted trains. Each train consists of two vessels operated in series in a lead/lag configuration (six tanks in total, IX-1A/2A, IX-1B/2B, and IX-1C/2C). Each ion exchange tank will have one rupture disk to protect it from excess pressure. The vessels are filled with a Dow resin which is highly selective for perchlorate. The resin cannot be regenerated and has to be replaced when it is spent. The system is designed with a hydraulic capacity of 6,900 gpm, and the hydraulic capacity for each train is approximately 2,300 gpm. The design perchlorate concentration for the system is 1.8 ppm. At 6,900 gpm and 1.8 ppm perchlorate, the resin in each vessel will need to be replaced in approximately 25 days. At lower flow rates and/or lower perchlorate concentrations, the resin is expected to last longer.

Filtered water leaving the Multi-Media Filters flows from the lead vessel through the lag vessel in series. Water leaving the lag tanks from the three trains flow to the Treated Water Tanks (TK-4A, TK-4B, and TK-4C). As the resin in the lead vessel becomes spent, the perchlorate concentration in the discharge from the lead vessel gradually rises. When the perchlorate concentration in the discharge from the lead vessel reaches 50 percent of the perchlorate concentration in the feed water, the resin in the lead vessel should be considered spent. Evoqua is responsible for replacing the resin in the vessels. As soon as it is discovered that the perchlorate concentration in the discharge from the lead vessels has reached 50 percent of the feed value, the operator must call Evoqua to arrange resin replacement in the lead vessel. When the resin is replaced in the lead vessel with fresh resin, the lead vessel becomes the new lag vessel and the old lag vessel becomes the new lead vessel.

To ensure that the resin bed is not plugged or the bed is not short circuited, the suspended solids must be removed from the water entering the ion exchange vessels. As indicated earlier, the Multi-Media Filters system is designed to remove TSS larger than 10 microns. According to Evoqua, suspended solids smaller than 10 microns would pass through the resin bed without disturbing the operation or performance of the resin.

3.3.7.1 Total Suspended Solids

An online TSS monitor (AIT-7010) will monitor the TSS level in the water that feeds into Ion Exchange System. When the TSS reading from AIT-7010 exceeds a pre-set value, an alarm is generated by the Master Control Panel and trigger an alarm callout.

3.3.7.2 Flow

Three magnetic flow meters (FM-7010, FM-7020, and FM-7030, for IX-1A/2A, IX-1B/2B, and IX-1C/2C, respectively) are installed on the individual inlet headers entering each ion exchange train (IX-1A/2A, IX-1B/2B, IX-1C/2C). The flowmeters will provide instantaneous and totalized flow of filtered flow entering each ion exchange skid. Operations are as follows:

- FM-7010 will measure instantaneous flow entering Ion Exchange Skid IX-1A/2A.
    - Instantaneous flow is sent to the Master Control Panel, where it is totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the ion exchange skid. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
- FM-7020 will measure instantaneous flow entering Ion Exchange Skid IX-1B/2B.
    - Instantaneous flow is sent to the Master Control Panel, where it is totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the ion exchange skid. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.
- FM-7030 will measure instantaneous flow entering Ion Exchange Skid IX-1C/2C.

- Instantaneous flow is sent to the Master Control Panel, where it is totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the ion exchange skid. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

Three electrically actuated on/off valves (XV-7010, XV-7020 and XV-7030) are installed on the individual inlet headers entering each ion exchange train (IX-1A/2A, IX-1B/2B, and IX-1C/2C). The valves are operated as commanded by the operator using the HMI on the Master Control Panel.

Each Ion Exchange Skid will have eight manually-operated valves to modify the lead/lag configuration of Ion Exchange tanks on each train. ***Table 6*** shows the valve designations for each train.

Table 6 Valve Designations for Ion Exchange Trains

Ion Exchange Train	Control Valves for Lead/Lag
1A/2A	BFV-701 through BFV-708
1B/2B	BFV-721 through BFV-728
1C/2C	BFV-741 through BFV-748

In order to configure the ion exchange tanks on a skid for a particular lead/lag operation, the lead/lag control valves will be positioned as shown in ***Table 7*** below:

Table 7 Valve Designations for Lead/Lag Operation of Ion Exchange Trains

Ion Exchange Train	Valve configuration for 1X lead/2X lag	Valve configuration for 2X lag/1X lead
1A/2A	*Open*: BFV-701, BFV-702, BFV-707, BFV-708 *Close*: BFV-703, BFV-704, BFV-705, BFV-706	*Open*: BFV-703, BFV-704, BFV-705, BFV-706 *Close*: BFV-701, BFV-702, BFV-707, BFV-708
1B/2B	*Open*: BFV-721, BFV-722, BFV-727, BFV-728 *Close*: BFV-723, BFV-724, BFV-725, BFV-726	*Open*: BFV-723, BFV-724, BFV-725, BFV-726 *Close*: BFV-721, BFV-722, BFV-727, BFV-728
1C/2C	*Open*: BFV-741, BFV-742, BFV-747, BFV-748 *Close*: BFV-743, BFV-744, BFV-745, BFV-748	*Open*: BFV-743, BFV-744, BFV-745, BFV-746 *Close*: BFV-741, BFV-742, BFV-747, BFV-748

3.3.7.3 Ion Exchange Resin Change-Out

Resin change-out will be performed by the Ion Exchange System supplier (Evoqua). For a detailed description of the procedures used by Evoqua during the resin change-out, refer to the supplier's operation manual.

During the change-out, the fresh resin is transported to the site by a service truck operated by the ion exchange supplier. The change-out procedures are as follows:

1. Isolate the ion exchange vessel containing resin that needs to be replaced (lead vessel) by closing the valves around the vessel; the lag vessel on the train will continue to operate.
2. Use hoses to connect the lead vessel to the truck.
3. Push the spent resin out of the ion exchange vessel through a resin discharge line via an air blower on the service truck.
4. Fill the vessel with the fresh resin from the truck through a resin fill line coming via the same blower as used for pushing spent resin out.
5. Position the valves on the ion exchange train so that the previous lag vessel becomes the new lead vessel, and the vessel containing the fresh resin becomes the new lag vessel (completed by supplier's operator).
6. Transport the spent resin off the site to an approved resin disposal facility (completed by supplier's operator).

3.3.7.4 Guidelines for Operators

1. Collect three water samples from each train on a daily basis: 1) the influent to the lead vessels, 2) the effluent from the lead vessel, and 3) effluent from the lag vessel. Submit for laboratory analysis of perchlorate.
2. Evaluate perchlorate concentrations in the lead and lag vessels to determine when the resin in the lead vessels has to be replaced.
3. Monitor the TSS concentration in the influent to the ion exchange lead vessels to ensure plugging and short circuiting would not occur.
4. When the perchlorate concentration in the discharge from the lead vessels is at 50 percent of the perchlorate concentration in the feed to the lead vessels, contact Evoqua immediately and arrange for resin replacement.
5. If the solids loading into the Ion Exchange System is consistently high and high-pressure drops are observed across the vessels, the resin may require replacement to avoid back-pressure build up in CWTP. If the pressure drop across an IX lead-lag pair exceeds 60 psi, the resin in the lead vessel should be replaced.
6. Operator must check the pressure and flow on each vessel daily by reading the values on the Human Machine Interface (HMI) on the Master Control Panel.

3.3.8 Treated Water Discharge System

3.3.8.1 Treated Water Tanks

Level Measurement

Four 20,000-gallon Baker-style Treated Water Tanks are used to store the treated water leaving the Ion Exchange System. The Treated Water Tanks are interconnected with a pipe manifold; the water level in the Influent Tanks is expected to equalize. One ultrasonic level sensor (LIT-8010) is installed on Treated Water Tank TK-4B. Another ultrasonic level sensor (LIT-8011) is installed on Treated Water Tank TK-4C to serve as a backup level sensor. Operations are as follows:

- LIT-8010 (or LIT-8011 backup if LIT-8010 is not in service) will continuously measure the water level in the Treated Water Tanks TK-4A, TK-4B TK-4C, and TK-4D. Operator-adjustable levels will include the following:
    - Low-Low Level: An alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout. Backup signal will be sent to turn OFF all Treated Water Pumps PU-6A, 6B and 6C.
    - Low Level: Minimum water level to turn OFF lead pump.

- Permissive Level One: Water level for two (lead) Treated Water Pumps operation.
- High Level: Water level for three (2 lead/1 lag) Treated Water Pumps operation.
- High-High Level: An alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout.
- The tanks have overflow piping that directs any overflow to the ground right next to the tank, from where it will drain eventually into the sump on site.

3.3.8.2 Treated Water Pumps

Three variable-speed Treated Water Pumps (PU-6A, 6B, and 6C) are used to transfer the treated water out of the Treated Water Tanks TK-4A, 4B, and 4C to the Las Vegas Wash through an 18-inch transmission line. A standby pump (PU-6D) is provided for redundancy. The pumps are controlled via level (as measured by LIT-8010) in the Treated Water Tanks (TK-4A, TK-4B, TK-4C, and TK-4D). The three Treated Water Pumps will operate in lead/lag mode (two lead and one lag). The configuration of pumps to be used as lead/lag will be manually cycled once per week by the operator. Operations are as follows:

- The following information for each of the Treated Water Pumps PU-6A, PU-6B, and PU-6C is monitored by the Master Control Panel:
  - Number of motor starts and stops.
  - Motor runtimes.
- As the water level in the Treated Water Tanks (TK-4A, TK-4B, TK-4C, and TK-4D) rises, the pumps are turned ON as follows:
  - Level reaches Permissive Level One: Two lead pumps ON.
  - Level reaches High Level: Lead pumps operating, and lag pump is turned ON.
  - Level reaches High-High Level: Alarm is transmitted to Master Control Panel to trigger an alarm callout.
- As the water level in the Treated Water Tanks (TK-4A, 4B, TK-4C, and TK-4D) drops, the pumps are turned OFF as follows:
  - Level drops below Lag OFF: Lag pump is turned OFF, and lead pumps remain operating.
  - Level drops below Low Level: Lead pumps turned OFF.
  - Level drops below the Low-Low Level: Alarm is transmitted to Master Control Panel and trigger an alarm callout. Backup signal will be sent to turn OFF all Treated Water Pumps.
- Operation of the Treated Water Pumps will also be controlled by the online TSS monitor AIT-8020 on the effluent line as described in Section 3.3.9.

3.3.8.3 Filter Backwash Pumps

Three variable-speed centrifugal Multi-Media Filters Backwash Pumps (PU-5A, PU-5B, and PU-5C) are used to provide filter rinse and backwash water using the treated water from Treated Water Tanks (TK-4A, TK-4B, TK-4C, and TK-4D). The pumps are operated via level (as measured by LIT-8010 or LIT-8011) in the Treated Water Tanks and as needed for the Multi-Media Filters Rinsing and Backwashing procedure per Section 3.3.4.6. The three Multi-Media Filters Rinse/Backwash Pumps will operate in two duty/one standby mode. The configuration of pumps to be used as duty/standby will be manually cycled once per week by the operator. Operations are as follows:

- The following information for each of the Multi-Media Filters Rinse/Backwash Pumps PU-5A, PU-5B and PU-5C are monitored by the Master Control Panel:
  - Number of motor starts and stops.

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    - Motor runtimes.
- When called by the Multi-Media Filters Control Panel to start Rinse/Backwash Procedure as described in Section 3.3.4.6:
    - The Master Control Panel will start the rinse and back procedures for selected Multi-Media Filters vessel.
    - The two duty pumps are operated by the Multi-Media Filters Control Panel per Section 3.3.4.6.
    - If one of the duty pumps fails to turn ON when commanded or if the Backwash Flow as measured by FM-8050 falls below a pre-set value (3000 gpm) for 2 minutes:
        - The standby pump will turn ON.
- When the water level in the Treated Water Tanks reaches a pre-set low level (2-3 ft.):
    - All pumps are turned OFF.

One magnetic flow meter (FM-8050) is installed on the backwash line from the Treated Water Tanks to the Multi-Media Filters.

- FM-8050 will measure instantaneous flow of backwash being sent to the Multi-Media Filters.
    - Instantaneous flow is sent to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the Multi-Media Filters. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

3.3.9 Treated Water Discharge

3.3.9.1 Discharge Flow

One magnetic flow meter (FM-8060) is installed on the effluent line out of the Treated Water Tanks to the Las Vegas Wash. FM-8060 will provide the instantaneous and totalized flow of the treated water being discharged to the Las Vegas Wash.

- FM-8060 will measure instantaneous flow of effluent being sent to the Las Vegas Wash.
    - Instantaneous flow is sent to the Master Control Panel, where it is totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the CWTP. Daily flows will be recorded and kept for 730 days. The lifetime flow will be recorded and kept for 730 days.

3.3.9.2 Total Suspended Solids

One online real-time TSS monitor (AIT-8060) is installed on the effluent line out of the Treated Water Tanks to the Las Vegas Wash. AIT-8060 will provide instantaneous TSS readings of flow entering the Las Vegas Wash. Operations are as follows:

- AIT-8060 will measure the instantaneous TSS concentration of effluent being sent to the Las Vegas Wash.
    - Instantaneous TSS readings is sent to the Master Control Panel. The TSS reading is recorded and kept for 730 days.
- When the instantaneous TSS reading measured by AIT-8020 reaches a pre-set value (120 ppm):
    - The pumping rate from Backwash Waste Pump PU-3A, 3B, and 3C is reduced to keep the TSS reading from AIT-8060 below 120 ppm.

- When the instantaneous TSS reading measured by AIT-8060 exceeds a pre-set value (120 ppm) for 5 minutes:
  - Alarm is generated. The alarm is transmitted to the Master Control Panel to trigger an alarm callout.

3.3.9.3 Example Blending Calculations

One of the design features of the Treatment Plant is that the solids that have been removed by the cyclones and the Multi-Media Filters are re-blended with the treated water before the treated water is discharged to the Las Vegas Wash. The cyclone underflow stream and backwash stream contribute perchlorate and TSS to the treated water discharge as part of blending. As a result, these calculations are important to avoid unacceptable discharge of perchlorate and TSS. In the event of discharge concentration being higher than the discharge limitations, the waste will not be blended with treated water, but instead will be trucked for offsite disposal. The following are example calculations of the effects of blending on TSS and perchlorate in the treated water discharge.

Example Blending Calculations for Total Suspended Solids

Example Calculation Assumption:

- Ion exchange flow: 4,600 gpm or 6,900 gpm
- Ion exchange TSS: 10 ppm
- Backwash flow: 20 gpm
- Backwash TSS: 4,000 ppm

Example Calculation of TSS Contribution from Feed Flow: 4,600 gpm

TSS in discharge = [(4,600 gpm x 10 ppm + 20 gpm x 4,000 ppm) / (4,600 gpm + 20 gpm)]

TSS in discharge = 27 ppm

Feed Flow: 6,900 gpm

TSS in discharge = [(6,900 gpm x 10 ppm + 20 gpm x 4,000 ppm) / (6,900 gpm + 20 gpm)]

TSS in discharge = 22 ppm

Example Blending Calculations for Perchlorate

Example calculations are provided below for the contribution of cyclone underflow perchlorate to treated water. The Treatment Plant is designed to operate with either two or three fixed speed pumps. Each pump has a capacity of 2,300 gpm. Therefore, the system can operate either at a flow rate of 4,600 gpm or a flow rate of 6,900 gpm. The example calculations shown below are completed for flow rates of 4,600 gpm and 6,900 gpm.

Example Calculation Assumptions:

- Total flow: 4,600 or 6,900 gpm
- Feed perchlorate: 1,800 ppb
- Cyclone underflow perchlorate: 1,800 ppb
- Underflow flow (small orifice): 10 gpm
- Underflow flow (large orifice): 38 gpm
- Ion exchange discharge perchlorate: 4 ppb
- Discharge limit for perchlorate: 18 ppb

Example Calculation of Perchlorate Contribution from Cyclone Underflow with Small Orifice:

The following is the example calculation of the perchlorate contribution from the cyclone underflow to the discharge stream at a feed flow rate of 6,900 gpm and 4,600 gpm assuming the small orifice is in use.

Feed Flow: 6,900 gpm

Perchlorate in discharge = [(10 gpm x 1,800ppb + 6,900 gpm x 4 ppb) / 6,910 gpm]

Perchlorate in discharge = 6.6 ppb

Therefore, the underflow from the cyclone at 10 gpm flow contributes an additional 2.6 ppb perchlorate to the discharge, for a total estimated combined discharge concentration of 6.6 ppb. Although this is well below the discharge limit of 18 ppb for perchlorate, the underflow is a significant contributor to perchlorate concentration in the discharge stream.

Feed Flow: 4,600 gpm

Perchlorate in discharge = [(10 gpm x 1,800 ppb + 4,600 gpm x 4 ppb) / 4,610 gpm]

Perchlorate in discharge = 7.9 ppb

Example Calculation of Perchlorate Contribution from Cyclone Underflow with Large Orifice:

The following is the example calculation of the perchlorate contribution from the cyclone underflow to the discharge stream at a feed flow rate of 6,900 gpm and 4,600 gpm assuming the large orifice is in use. The larger orifice will be in use if the influent water has TSS concentration greater than 500 ppm.

Feed Flow: 6,900 gpm

Perchlorate in discharge = [(38 gpm x 1,800 ppb + 6,900 gpm x 4 ppb) / 6,938 gpm]

Perchlorate in discharge = 13.8 ppb

Therefore, the underflow from the cyclone at 38 gpm contributes an additional 9.8 ppb perchlorate to the discharge, for a total estimated combined discharge concentration of 13.8 ppb. This reflects the significant role that the underflow plays in perchlorate concentration in the discharge stream.

Feed Flow: 4,600 gpm

Perchlorate in discharge = [(38 gpm x 1,800 ppb + 4,600 gpm x 4 ppb) / 4,638 gpm]

Perchlorate in discharge = 18.7 ppb

As the feed flow to the Treatment Plant drops from 6,900 gpm to 4,600 gpm, the contribution from the cyclone underflow to the treated water perchlorate concentration rises from 9.9 ppb to 14.7 ppb. This condition would only occur if the influent water TSS concentration is greater than 500 ppm continuously throughout the day. Under these conditions, the estimated combined discharge concentration is 18.7 ppb. This exceeds the NPDES permit discharge limit for perchlorate of 18 ppb, and the cyclone waste will need to be trucked for offsite disposal.

4.0 OPERATIONAL AND TROUBLESHOOTING GUIDANCE

4.1 OPERATIONAL GUIDANCE

To ensure proper function of the system, the operator must perform all activities described below.

4.1.1 Flow Rate

- Monitor water flow rate to HLPS.
- Monitor water flow rate to SMPS.
- Monitor flow rate to cyclones.
- If flow entering cyclones exceeds the design flow of 6,900 gpm, the control system will compare flows from both weirs and shut off the control valve on the line with the smaller flow rate.
- If any one of the control valves on the pipelines bringing water to the two pump stations gets shut off, immediately contact SNWA operator and inform them if the control valve has been closed or throttled down.
- As soon as the total flow drops below 6,900 gpm, contact the SNWA operator and inform him that control valve has opened.
- Monitor flow to the two cyclones to ensure flow is being distributed properly between the two units.
- Monitor flow to the three Multi-Media Tanks.
- Monitor flow to the six chambers of the Multi-Media Filters system.

4.1.2 TSS Concentration

- Monitor TSS on the water entering the HLPS and SMPS.
- If TSS is higher than 500 ppm in water entering either pump stations, you have the option to start the polymer systems at the pump stations.
- When TSS falls below 500 ppm in water entering either pump station, check to see if the polymer systems at either or both pump stations are on. If so, turn off the polymer systems at the pump stations.
- Monitor the TSS on the combined line entering cyclones.
- If the TSS in the combined flow to the cyclones is less than 400 ppm, turn the small orifice underflow valve and maintain a flow rate between 10 and 20 gpm.
- If the TSS in the combined stream to cyclones is higher than 400 ppm, switch the cyclone underflow orifice to the larger orifice size. As the TSS in the combined flow increases from 400 ppm to 5,000 ppm, increase the underflow flow rate from 30 gpm to 100 gpm.
- If the TSS in the cyclone overflow is higher than 500 ppm, turn on the polymer system at CWTP.
- Adding 10 mg/L ferric chloride as coagulant will improve the effectiveness of polymer in removing solids contained in the overflow stream from cyclones at the multi-media filters.
- If TSS in the cyclone overflow is less than the permit limit of 135 mg/L, the operator has the option of not using coagulant and polymer; however, even at low TSS concentration coagulant and polymer can be used to remove TSS from water very effectively.
- Colloidal solids (solids which are very difficult to settle) have been observed at low concentration in water from the Sunrise Mountain Weir. Tests have shown that removal of these solids is improved when coagulant is used with the polymer.
- If the TSS in the cyclone overflow drops below 500 ppm, turn off the polymer system at CWTP.
- If TSS in the combined stream is higher than 120 ppm, you have the option to divert the cyclone underflow stream to the Cyclone Waste Tank.
- If TSS in the combined stream to the cyclones is lower than 120 ppm, you have the option to divert the cyclone underflow to the Backwash Waste Tank.
- Monitor TSS concentration in the backwash waste stream.

- Monitor TSS concentration in the discharge stream to the Las Vegas Wash. If TSS in the discharge stream rises above 120 ppm, lower flow rate of the backwash waste stream to discharge pipe.
- Calculate TSS concentration in the discharge stream using flow and TSS concentrations in the ion exchange discharge and backwash waste flow, and compare to the value reported by the TSS meter on the discharge line.

4.1.3 Perchlorate Concentration

- Collect samples from internal process control sampling locations daily and submit for in-house laboratory analysis of perchlorate.
- Collect samples from effluent lines from lead and lag vessels of the Ion Exchange System and analyze for perchlorate.
- If the perchlorate concentration in the discharge line of any one of the lead vessels rises to 50 percent of the perchlorate concentration in the feed water immediately call Evoqua and arrange for resin replacement in the particular lead vessel.
- If the pressure drop across the ion exchange vessels rises above the recommended value immediately call Evoqua and arrange for a service person to come to the site to evaluate the causes for pressure drop rise.
- If the perchlorate concentration in the lag vessels of the Ion Exchange System rises above 4 ppb, the operator must contact Evoqua immediately. Evoqua will troubleshoot the issue.

4.2 TROUBLESHOOTING GUIDANCE

The following table provides troubleshooting guidance for some of the more common potential situations that may be encountered during operation of the Treatment Plant.

Table 8 Troubleshooting Guidance

Symptom	Cause	Corrective Action
1. High flow at CWTP	1. High flow at HLPS	1. Check flow meter at HLPS to make sure reading ok.
	2. High flow at SMPS	2. Check flow meter at SMPS to make sure reading ok.
		3. If combined flow at CWTP higher than 6,900 gpm, computer will shut off control valve at lower flow automatically.
		4. If valve is shut off, call SNWA operator immediately informing them of valve shut off.
		5. When flow at CWTP falls below 6,900 gpm, valve will open automatically.
		6. When valve opens call SNWA to let them know that the valve is open.
		7. Confirm that the pressure drop across the Y-strainer is low to allow proper flow through the plant.

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Symptom	Cause	Corrective Action
2. Discrepancy in flow measurement	1. Malfunctioning flow meter	1. Conduct a hydraulic balance using various flow meters.
		2. Identify the broken flow meter.
		3. Repair or replace flow meter.
3. High Perchlorate in discharge	1. Spent ion exchange resin	1. Check perchlorate in lead /lag ion exchange tanks.
	2. High cyclone underflow flow	2. If resin is spent, contact Evoqua for resin replacement.
	3. High perchlorate in feed stream	3. Check cyclone underflow flow rate.
	4. Rinse water from filters contains perchlorate	4. Check cyclone underflow valve positions.
		5. If need be, change cyclone underflow valve position.
		6. Check perchlorate concentration in backwash waste leaving Backwash Waste Tank.
		7. Reduce Backwash Waste Tank flow to discharge line.
		8. Check perchlorate in a sample of rinse water.
4. High TSS in HLPS	1. Storm condition	1. Check TSS on the combined line to the cyclones.
	2. Installation of new sump at the weir	
	3. Start-up operation at the weir	2. If TSS in the cyclone overflow is greater than 500 ppm, turn on the polymer system at CWTP.
	4. Change in construction activities at weir	3. Confirm that the pressure drop across the cyclones is within the specified 50-55 psi range.
		4. If TSS in combined line to cyclones is greater than 400 ppm, switch the cyclone underflow valve position to larger orifice.

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Symptom	Cause	Corrective Action
5. High TSS in SMPS	1. Storm condition	1. Check TSS on the combined line to the cyclones.
	2. Installation of new sump at the weir	
	3. Start-up operation at the weir	2. If TSS in the cyclone overflow is greater than 500 ppm, turn on the polymer system at CWTP.
	4. Change in construction activities at weir	3. Confirm that the pressure drop across the cyclones is within the specified 50-55 psi range.
		4. If TSS in combined line to cyclones is greater than 400 ppm, switch the cyclone underflow valve position to larger orifice.
6. High TSS in discharge stream	1. High backwash waste flow	1. Check backwash waste flow to discharge pipe.
	2. High cyclone underflow flow	2. If backwash flow is high, reduce pump speed to reduce flow.
	3. High cyclone underflow TSS	3. Conduct a mass balance on TSS to determine desired backwash waste flow.
	4. Cyclone malfunction	4. Check cyclone underflow flow rate.
		5. If cyclone underflow flow is high, switch the underflow valve setting.
		6. Check solid content in cyclone underflow stream.
		7. If solids are high, divert underflow to Cyclone Waste Tank.
7. High pressure drop across Multi-Media Filters	1. One chamber needs to be backwashed	1. Check backwash schedule to see if backwash is needed on one of the chambers.
	2. Faulty pressure sensors	2. Check pressure sensors to see if faulty; change if necessary.
	3. Too much solids in feed water to filters	3. Check TSS meters to see if too much solids are leaving cyclones.
		4. Confirm that the polymer system is on.
	4. Cyclone overflow contains higher than expected solids	5. Check solids in feed to cyclones and effluent from cyclones to see if as expected.

Symptom	Cause	Corrective Action
8. High pressure drop across ion exchange tanks	1. Ion exchange tanks are plugged	1. Call Evoqua and describe the problem; if need be request a site visit.
	2. Solids in feed water to ion exchange system is too high	2. Checks solids in feed to ion exchange to make sure as expected.
	3. Ion exchange resin beds are short circuiting	3. Discuss resin bed short circuiting with Evoqua.

5.0 MAINTENANCE

This section provides a summary of equipment, spares, and maintenance activities is provided below. Manufacturer Installation, Operations and Maintenance (IOM) Manuals for specific equipment are included in Appendices B through G. These IOM manuals identify specific maintenance tasks for equipment.

5.1 EQUIPMENT LIST

The list of primary equipment associated with the Treatment Plant is included in Appendix H. ***Table 9*** provides a list of equipment spares.

Table 9 Equipment Spares List

Equipment	Description	Tag Number	Notes
Influent pumps	The influent pumps at SMPS and HLPS have a common shelf spare.	PU-1D or PU-2D	
Treated Water Discharge Pumps	The four Treated Water Discharge pumps include a spare.	PU-6A PU-6B PU-6C PU-6D	The configuration of pumps to be used as duty/spare will be manually cycled once per week by the operator.
Filter Backwash Pumps	The three Filter Backwash pumps include a spare.	PU-5A PU-5B PU-5C	The configuration of pumps to be used as duty/spare will be manually cycled once per week by the operator.
Cyclone Waste Transfer Pump	The two Cyclone Waste Transfer pumps include a spare.	PU-4A PU-4B	The configuration of pumps to be used as duty/spare will be manually cycled once per week by the operator.

5.2 PREVENTATIVE MAINTENANCE

Routine preventative maintenance measures will be performed to identify problems quickly and resolved them in a timely manner. ***Table 10*** below shows routine maintenance measures for the pump stations and the CWTP. More detailed maintenance measures for each equipment are described in the IOM manuals in the appendices.

Table 10 Preventative Maintenance Measures

Frequency	Process	Description
Daily	General	Check that all operating equipment and instruments are working properly. Inform TT of any non-working equipment and instruments.
	SMPS and HLPS	Visually inspect all tanks, pumps, pipes and valves for leaks or signs of damage.
		Fill out inspection and operational logs.

Frequency	Process	Description
Daily	CWTP	Visually inspect all tanks, pumps, pipes and valves for leaks or signs of damage.
		Fill out inspection and operational logs.
Monthly	General	Check quantities of all spare parts and materials and reorder as needed.
		Verify operation of pumps.

5.3 ROUTINE MAINTENANCE

5.3.1 Centrifugal Pumps

Specific maintenance timeframes are dependent on use of pumps and the general guidelines are listed in the IOM manual for the Centrifugal pumps in Appendix B. The IOM manual also includes details on inspections and maintenance. The operator shall periodically check the pumps for any excessive vibrations.

5.3.2 Progressing Cavity Pumps

Specific maintenance tasks for the Progressing Cavity pumps are listed in the IOM manual for Progressing cavity pumps in Appendix C. The manual includes guidelines for pump storage, inspection and lubrication.

5.3.3 Multi-Media Filters

The operator should periodically check for any media losses. The recommended interval for checking for media loss is for every 4 months. The operator will inform TT after a media loss of more than 10%. Specific maintenance tasks for the Multi-Media Filters are listed in the IOM manual in Appendix D.

5.3.4 Ion Exchange System

Specific inspection and maintenance schedules for the Ion Exchange system are listed in the IOM manual in Appendix E. The IOM manual has a detailed description of the system, start-up and maintenance schedules.

5.3.5 Cyclones

The operator shall perform routine inspection of the piping and the valves to detect any leaks. Specific inspection and maintenance schedules for the Cyclones are listed in the IOM manual in Appendix F.

5.3.6 Submersible Pumps

Specific instructions on inspection and maintenance schedules for the Submersible Pumps are listed in the IOM manual in Appendix G. The manual also includes information of start-up, and assembly and disassembly.

6.0 START-UP SEQUENCE

6.1 GENERAL REQUIREMENTS

The standard specifications for the project cover the minimum requirements for the plant start-up sequence. For different unit operations, the respective O&M manual will be followed. Although the specific requirements for each unit operation is different, the general aspects will follow this standard start-up sequence.

- This start-up sequence will include steps that are to be taken as soon as the SNWA operator starts pumping the groundwater to the pump stations.
- Prior to start-up, the responsibilities of the operator will be clarified.
- Prior to start-up, each piece of equipment will have a nameplate.

6.2 STEPS PRIOR TO START-UP:

Prior to start-up, the operator will complete the following tasks:

- Review this document in total and clarify any questions.
- Review the O&M manuals from each manufacturer.
- Review the spare parts inventory.
- Review equipment and piping location.

6.3 PROCEDURES FOR START-UP

The following subsections discuss the start-up sequence for the project. The subsections have been identified based on the different operations.

6.3.1 Sunrise Mountain Pump Station

Before the groundwater from the Sunrise Mountain Weir construction site is pumped to SMPS, the operator will be notified. The operator will make sure that valves BFV-201, BFV-202 are open and valve BFV-203 is closed. The BFV-201 and BFV-202 are open at all times, while BFV-203 is closed at all times. The only time valves BFV-201 and BFV-202 are closed and BFV-203 is open is when the flowmeter must be serviced or replaced. Under that scenario, the flow meter is isolated by closing the valves BFV-201 and BFV-202 and opening valve BFV-203.

6.3.1.1 Polymer Feed System

Before the groundwater flows into the Influent Tanks (TK-1A, 1B, 1C, 1D, 1E), if TSS in the influent water is higher than 500 ppm, the operator has the option to add polymer to the groundwater to settle a portion of the solids in the influent tanks. The operator should check and record the polymer level in the polymer tote (TK-8). The operator should make sure the valves from the polymer tote, valves from the potable water tank (TK-7), and valve BV-201, which meters diluted polymer to the influent pipeline, have the following positions:

- BV-210 Open
- BV-211 Open
- BV-214 Open
- BV-215 Open

- BV-201 Open

6.3.1.2 Influent Tanks

The following valves are installed on the influent pipe to the Influent Tanks (TK-1A, 1B, 1C, 1D, and 1E). These valves are opened by the operator. These valves will remain open during normal operation.

- BFV-205 – TK-1A Open
- BFV-207 – TK-1B Open
- BFV-209 – TK-1C Open
- BFV-211 – TK-1D Open
- BFV-226 – TK-1E Open

Operator will also open valve BV-231 to ensure normalized flow in all the Influent Tanks. This valve will remain open at all times. There are drain valves on the Influent Tanks. These valves should have the following position:

- BV-202 Closed
- BV-204 Closed
- BV-206 Closed
- BV-208 Closed
- BV-232 Closed

There are also a number of sampling valves on the drain lines from these tanks. These valves will also be closed.

6.3.1.3 Influent Pumps

The operator will make sure the valves on the effluent line of the Influent Tanks are open. These valves are open at all times during normal operation. These valves are as follows:

- BFV-206 – TK-1A Open
- BFV-208 – TK-1B Open
- BFV-210 – TK-1C Open
- BFV-212 – TK-1D Open
- BFV-228 – TK-1E Open

The operator will also make sure the valves on the influent side of the influent pumps (PU-1A/B/C) are in the open position. These valves are open at all times during normal operation. These valves are as follows:

- BFV-213 – PU-1A Open
- BFV-215 – PU-1B Open
- BFV-217 – PU-1C Open

Operator will make sure valve BFV-219 is closed. This valve will only be opened when spare shelf pump has to be used to replace one of the operating pumps. The operator will then close the valve for the pump that needs to be serviced or replaced with the shelf pump.

The operator will open the valves on the effluent line of the Influent Pumps (PU-1A/B/C) for the groundwater to be pumped to the CWTP. These valves will then remain open at all times during normal operation. These valves are as follows:

- BFV-214 – PU-1A Open
- BFV-216 – PU-1B Open

- BFV-218 – PU-1C Open

Operator will open valve BV-220 if the shelf spare pump is connected to the line and close corresponding valve from the pump that is taken out of operation.

6.3.2 Historic Lateral Pump Station

Before the groundwater from the Historic Lateral Weir construction site is pumped to HLPS, the operator will be notified. Then, the operator will check the position of the following valves:

- BFV-301 Open
- BFV-302 Open
- BFV-303 Closed

The above valve positions will remain during normal operation. In the event the flow meter needs to be repaired or replaced, then valves BFV-301 and BFV-302 are closed to isolate the flow meter and valve BFV-303 is opened to continue normal operation.

6.3.2.1 Polymer Feed System

Before the groundwater from flows into the Influent Tanks (TK-2A/B/C/D), if TSS in the influent water is higher than 500 ppm, the operator has the option to add polymer to the groundwater to settle a portion of the solids in the influent tanks. The operator should check and record the polymer level in polymer tote (TK-10). The operator should make sure the valves from the polymer tote, valves from the potable water tank (TK-9), and valve BV-302, which meters diluted polymer to the influent pipeline, have the following positions:

- BV-311 Open
- BV-312 Open
- BV-315 Open
- BV-316 Open
- BV-302 Open

6.3.2.2 Influent Tanks

For the Historic Lateral Pump Station (HLDS), the valves installed on the influent pipes to the Influent Tanks (TK-2A, 2B, 2C, and 2D) are set to the following position:

- BFV-305 – TK-2A Open
- BFV-307 – TK-2B Open
- BFV-309 – TK-2C Open
- BFV-311 – TK-2D Open

6.3.2.3 Influent Pumps

The operator will set the valves on the effluent line of the Influent Tanks to the following position during start-up. These valves are normally open at all times. These valves are as follows:

- BFV-306 – TK-2A Open
- BFV-308 – TK-2B Open
- BFV-310 – TK-2C Open

- BFV-312 – TK-2D	Open

The operator will also set the valves on the influent side of the influent pumps (PU-1A/B/C) to the following position during start-up. These valves are normally open at all times. These valves are as follows:

- BFV-313 – PU-2A	Open
- BFV-315 – PU-2B	Open
- BFV-317 – PU-2C	Open

Operator will open valve BFV-319 in case the shelf spare pump is connected to the line. Under this scenario, the corresponding valve for the pump that needs to be repaired or replaced must be closed.

The operator will set the valves on the effluent line of the influent pumps (PU-2A, 2B, and 2C) for the groundwater to be pumped to the CWTP to the following position. These valves will then remain open at all times. These valves are as follows:

- BFV-314 – PU-2A	Open
- BFV-316 – PU-2B	Open
- BFV-318 – PU-2C	Open

Operator will open valve BV-320 if the shelf spare pump is connected to the line. Under this scenario, the valve for the pump that is taken off line will be closed.

6.3.3 Combined Influent Groundwater to Central Water Treatment Plant

A common influent header with combined influent from SMPS and HLPS runs to the CWTP. The operator will set valves BFV-401, BFV-402 and BFV-403 to the following position:

- BFV-401	Open
- BFV-402	Open
- BFV-403	Closed

Valve BFV-403 is opened and valves BFV-401 and BFV-402 are closed if the flow meter needs to be repaired or replaced. Valve XV-4010 is an electric actuated valve that can be opened and closed by a push button on the main control panel. This valve will be closed if a major problem occurs in the Treatment Plant. Closing this valve shuts off the operation of all pumps from the pump stations.

6.3.4 Cyclone Separators

Although the operation of the cyclone separators is automatic, the operator will review the O&M manual from the cyclone manufacturer. Each cyclone has a valve on the underflow line from the cyclone. The underflow lines from the two cyclones combine and can leave through two different valves. These valves have different size orifices. The valve with the smaller orifice size allows less underflow while the valve with the larger orifice allows more underflow. The operator should set the underflow valves to the following positions during start-up:

- KGV-501	Open
- KGV-521	Open
- KGV-502	Open
- KGV-522	Closed

Valve KGV-502 has the smaller orifice. The operator may decide to close KGV-502 and open KGV-522 if TSS concentration in the feed water to cyclone exceeds 500 ppm.

The underflow from the cyclones can either go to the Cyclone Waste Tank or the Backwash Waste Tank. Switching the destination for the cyclone underflow between the two tanks is the operator's decision and must be done manually. During start-up, the cyclone underflow will go to the Backwash Waste Tank. The operator will set the valves to the following position:

- KGV-805 Open
- KGV-806 Open
- KGV-803 Open
- KGV-807 Closed
- KGV-801 Closed

In the event flowmeter FM-8020 needs to be repaired or replaced, then valves KGV-805 and KGV-806 are closed to isolate the flow meter, and valve KGV-807 is opened.

To send the cyclone underflow to the Cyclone Waste Tank instead of the Backwash Waste Tank, the valves should be set to the following positions:

- KGV-805 Open
- KGV-806 Open
- KGV-801 Open
- KGV-803 Closed
- KGV-807 Closed

It should be noted that valve KGV-802 on the discharge line from the Cyclone Waste Tank should be open at all times during start-up and normal operation. All valves on sample lines are closed unless the operator is collecting a sample.

6.3.5 Multi-Media Filter Polymer System

Before the cyclone effluent flows into the Multi-Media Filters, the effluent is pre-treated with polymer. The neat polymer is mixed with water in a mixing chamber and the diluted polymer is pumped to the influent line to the Multi-Media Filters. The operator will check and record the neat polymer levels in polymer tote (TK-11). The operator will set the following valves to the position indicated below during start-up:

- BV-650 Open
- BV-651 Open
- BV-840 Open
- BV-640 Open
- BV-654 Open
- BV-611 Open

6.3.6 Multi-Media Filters

The Multi-Media Filters System is a skid-mounted unit supplied by WesTech. The system consists of flow meters and control valves which operate automatically to distribute water to various chambers and determine when a chamber has to be rinsed and backwashed. Although the operation of the Multi-Media Filters is automatic, the operator will review the O&M manual from the Multi-Media Filters vendor. The operator will set valves which are at the influent line to the filters to the following positions during start-up:

- BFV-601 Open
- BFV-602 Open
- BFV-603 Closed

These valves allow the cyclone effluent stream to be transferred to the common header of the Multi-Media Filters.

Clean water from the Treated Water Tanks is used to supply the filters during rinse and backwash operations. The operator will make sure the valves are in the following positions during start-up. These valves are located at the inlet to and outlet from the Filter Rinse/Backwash Pumps at the Treated Water Tanks.

- BFV-821 Open
- BFV-823 Open
- BFV-829 Open
- BFV-822 Open
- BFV-824 Open
- BFV-830 Open
- BFV-825 Open
- BFV-826 Open
- BFV-843 Open
- BFV-827 Closed

Valve BFV-827 is closed during start-up and normal operation. In the event the flow meter FM-8050 needs to be repaired or replaced, valve BFV-827 is opened and valves BFV-825 and valve BFV-826 are closed to isolate the flow meter.

The rinse water from the filters goes to the Filter Rinse Water Transfer Tank. From the Filter Rinse Water Transfer Tank, rinse water is to the Ion Exchange System for treatment. The valve positions in the influent to and effluent from the Filter Rinse Water Tank should be set to the following positions during start-up:

- BFV-802 Open
- BFV-803 Open
- BFV-831 Open
- BFV-833 Open
- BFV-832 Open
- BFV-834 Open
- BFV-835 Open
- BFV-836 Open
- BFV-840 Closed

BFV-840 is the bypass valve. In the event that the flow meter FM-8065 needs to be repaired or replaced, the valve BFV-840 is opened and valves BFV-835 and valve BFV-836 are closed to isolate the flow meter. All valves on sample lines are closed except when the operator is ready to collect samples.

The backwash from the Multi-Media Filters is sent to two Backwash Waste Tanks. From the Backwash Waste Tank, variable speed pumps are used to send the backwash waste to the effluent line going to the Las Vegas Wash. The valves located on the influent lines to and effluent lines from the Backwash Waste Tanks should be set to the following positions during start-up:

- BFV-800 Open
- BFV-841 Open
- BFV-842 Open
- PV-809 Open
- PV-811 Open
- PV-813 Open
- PV-810 Open
- PV-812 Open
- PV-814 Open
- PV-801 Open
- PV-802 Open
- PV-800 Open
- PV-803 Closed

PV-803 is closed during normal operation. In the event the flow meter FM-8045 needs to be repaired or replaced, PV-803 is opened and valves PV-801 and PV-802 are closed to isolate the flowmeter.

The operator will open the following valves on the influent side of the Backwash Waste Tanks (TK-3A/B):

- BFV-800, BFV-841, BFV-842: From Filter backwash common header to TK-3A/B
- KGV-840, KGV-842: From cyclone underflow to TK-3A/B
- KGV-841, KGV-843: From cyclone waste pumps (PU-4A/B) to TK-3A/B

The operator will also open the following valves on the effluent side of the Backwash Waste Tanks (TK-3A/B):

- PV-804: From TK-3A
- PV-816: From TK-3B

6.3.7 Ion Exchange System

The operator will open valve BFV-551 for the Multi-Media Filters effluent to enter the Ion Exchange System common header. The operator will also open the valve BFV-550 for the rinse water stream. The rinse water transfer pumps (PU-7A and 7B) operate automatically based on the level in the Filter Rinse Water Transfer Tank (TK-6).

6.3.8 Cyclone Waste Pumps

The operator will open the following valves on the influent side of the Cyclone Waste Pumps (PU-4A and 7B). These valves will remain open at all times. These valves are:

- KGV-832: PU-4A
- KGV-835: PU-4B

The operator will also open the following valves on the effluent side of the Cyclone Waste Pumps. These valves will remain open at all times. These valves are:

- CV-807, KGV-834: PU-4A
- CV-808, KGV-837: PU-4B

The flow rate is monitored before the flow is directed towards the Backwash Waste Tanks (TK-3A/B). For this, the operator will open the valves KGV-817, KGV-818, KGV-819, and KGV-821. Valves KGV-817, KGV-818, and KGV-819 will be open at all times, and KGV-819 will be closed.

6.3.9 Backwash Waste Pumps

The operator will open the following valves on the influent side of the Backwash Waste Pumps (PU-3A, 3B, and 3C). These valves will remain open at all times. These valves are:

- PV-809: PU-3A
- PV-811: PU-3B
- PV-813: PU-3C

The operator will also open the following valves on the effluent side of the Backwash Waste Pumps. These valves will remain open at all times. These valves are:

- CV-809, PV-810: PU-3A
- CV-810, PV-812: PU-3B
- CV-811, PV-814: PU-3C

The flow rate is monitored before the flow is directed towards the Treated Water Effluent Pumps Discharge header. For this, the operator will open the valves PV-801, PV-802, PV-803, CV-806, and PV-800. Valves PV-801, PV-802 are open at all times, and PV-803 is closed.

6.3.10 Filter Rinse/Backwash Pumps

The operator will open the following valves on the influent side of the Filter Rinse/Backwash Pumps (PU-5A, 5B, and 5C). These valves will remain open at all times. These valves are:

- BFV-821: PU-5A
- BFV-823: PU-5B
- BFV-829: PU-5C

The operator will also open the following valves on the effluent side of the Filter Rinse/Backwash Pumps. These valves will remain open at all times. These valves are:

- CV-821, BFV-822: PU-5A
- CV-822, BFV-824: PU-5B
- CV-823, BFV-830: PU-5C

The flow rate is monitored before the flow is directed towards the Multi-Media Filters Rinse/Backwash header. For this, the operator will open the valves BFV-825, BFV-826 and BFV-843. These valves will remain open at all times. BFV-827 is closed.

6.3.11 Filter Rinse Water Transfer Pumps

The operator will open valve BFV-802 and BFV-803 on the influent side and the effluent side of the Filter Rinse Water Transfer Tank (TK-6).

The operator will open the following valves on the influent side of the Rinse Water Transfer Pumps (PU-7A and 7B). These valves will remain open at all times. These valves are:

- BFV-831: PU-7A
- BFV-833: PU-7B

The operator will also open the following valves on the effluent side of the Rinse Water Transfer Pumps. These valves will remain open at all times. These valves are:

- CV-831, BFV-832: PU-7A
- CV-832, BFV-834: PU-7B

The flow rate is monitored before the flow is directed towards the Ion Exchange feed header. For this, the operator will open the valves BFV-835 and BFV-836. These valves will remain open at all times. Valve BFV-840 remain closed.

6.3.12 Treated Water Tanks and Discharge Pumps

Water flows from the Ion Exchange System to four Treated Water Tanks. The valves on the influent line to the Treated Water tanks (TK-4A/B/C/D) should be set to the following positions:

- BFV-804 – TK-4A Open
- BFV-806 – TK-4B Open
- BFV-814 – TK-4C Open
- BFV-818 – TK-4D Open

The valves on the effluent line of the Treated Water tanks are set to the following positions

- BFV-805 – TK-4A Open
- BFV-807 – TK-4B Open
- BFV-815 – TK-4C Open
- BFV-819 – TK-4D Open

The valves on the influent to and effluent from the Treated Water Pumps (PU-6A, 6B, 6C, and 6D) are set to the following positions:

- BFV-808 – PU-6A Open
- BFV-810 – PU-6B Open
- BFV-812 – PU-6C Open
- BFV-816 – PU-6D Open
- BFV-809 – PU-6A Open
- BFV-811 – PU-6B Open
- BFV-813 – PU-6C Open
- BFV-817 – PU-6C Open

6.3.13 Discharge to Las Vegas Wash:

The operator will open the valves BFV-837, BFV-838 and BFV-839. BFV-837 and BFV-838. These valves will remain open at all times.

7.0 SHUTDOWN SEQUENCE

7.1 EMERGENCY SHUTDOWN SEQUENCE

In the event of a major equipment failure at the treatment plant, the operator will follow the emergency shutdown sequence. The main objectives of the emergency shutdown sequence are as follows:

- Avoid any damage to the equipment.
- Avoid spillage of untreated groundwater.
- Prevent pressure build-up in the lines.

The emergency shutdown sequence can be initiated by closing the valve XV-4010. The valve can be closed by pressing the push button on the main control panel. Shutting down this valve will stop all pumping operations, thereby shutting down the treatment plant. The on-site engineering team will evaluate the issue. After resolving the issue, the valve XV-4010 is opened by the operator.

In the event of an emergency at either of the pump stations, pumping operations are stopped at the respective pump station.

7.1.1 Sunrise Mountain Pump Station Emergency Shutdown

In the event of any emergency at the SMPS, the valve XV-2010 is manually closed by the operator. The operator will then contact the SNWA operator and inform them that the pump station has been shut down. To isolate the pump station, the operator will manually close the following valves on the pump effluent line:

- BFV-214
- BFV-216
- BFV-218
- BFV-220 (if the spare pump has been connected)

7.1.2 Historic Lateral Pump Station Emergency Shutdown

In the event of any emergency at the HLPS, the valve XV-3010 is manually closed by the operator. The operator will then contact the SNWA operator and inform them that the pump station has been shut down. To isolate the pump station, the operator will manually close the following valves on the pump effluent line:

- BFV-314
- BFV-316
- BFV-318
- BFV-320 (if the spare pump has been connected)

7.2 PERMANENT SHUTDOWN SEQUENCE

At the end of the project, the operator will follow the permanent shutdown sequence. This sequence is followed for plant shutdown prior to decommissioning the pump stations and the treatment plant.

To shut down the pump stations, valves XV-2010, XV-3010 and XV-4010 are closed. This will shut down all pumping operation in both the pump stations. As the cyclones operate based on pressure differential caused by the flow in the cyclone influent header, and closing valve XV-4010 in turn shuts down the Treatment Plant.

The Influent Tanks TK-1A, 1B, 1C, 1D, and 1E and TK-2A, 2B, 2C, and 2D will have residual groundwater in them. Based on the appearance of the water, a decision will be made whether to vacuum truck the water off-site or to pump the water to the Treatment Plant. Any solids present in any of the other storage tanks, including the

Cyclone Waste Tank, will be trucked off-site. The operator will follow the shutdown sequence in the O&M manuals of the Cyclones, Multi-Media Filters, and Ion Exchange Systems.

8.0 REGULATORY FRAMEWORK

8.1 NDPES DISCHARGE PERMIT

Treated water leaving the CWTP is discharged to the Las Vegas Wash under NPDES Permit Number: NV0024228. The permit was issued on August 14, 2017, and will expire August 13, 2022. This section provides a summary of the NPDES permit. The actual NPDES should be referenced for all activities covered under the NPDES permit.

8.2 DESIGNATED OUTFALLS AND DISCHARGE LIMITS

The designated Outfalls from the treatment facility are summarized in ***Table 11***.

Table 11 Designated Outfalls

Sample Location	Location Type	Location Name
001	Influent Structure	001 COMBINED INFLUENT SMPS & HLPS AT CWTP
002	Internal Outfall	002 BACKWASH WASTE PUMP
003	External Outfall	003 TREATED EFFLUENT
004	Receiving Water - Ambient	004 END OF MIXING ZONE LOS VEGAS WASH AMBIENT WATER QUALITY MONITORING POINT

The discharges limits for Outfalls 001, 002, 003, and 004 are summarized below in ***Table 12***, ***Table 13***, ***Table 14***, and ***Table 15***, respectively.

Table 12 Discharge Limits for Outfall 001

Discharge Limitations				Monitoring Requirements			
Parameter	Base	Quantity	Concentration	Monitoring Location	Sample Location	Measurement Frequency	Sample Type
Flow Rate	Daily Max	≤ 6,900 gpm		Intake	001	Continuous	Meter
pH	Value		M&R STD Units	Intake	001	Biweekly	Grab
TSS	Daily Max		M&R, mg/L	Intake	001	Biweekly	Composite
TDS	Daily Max		M&R, mg/L	Intake	001	Biweekly	Composite
Perchlorate	Daily Max		M&R, mg/L	Intake	001	Biweekly	Composite
Nitrogen, Total	Daily Max		M&R, mg/L	Intake	001	Monthly when Discharging	Composite

Discharge Limitations				Monitoring Requirements			
Parameter	Base	Quantity	Concentration	Monitoring Location	Sample Location	Measurement Frequency	Sample Type
Ammonia-N total (as N) 30 day	Daily Max		M&R, mg/L	Intake	001	Monthly when Discharging	Composite
Phosphorus, Total	Daily Max		M&R, mg/L	Intake	001	Monthly when Discharging	Composite

Note: M&R: Measure and Report; mg/L: milligrams per liter; TDS: total dissolved solids

Table 13 Discharge Limits for Outfall 002

Discharge Limitations				Monitoring Requirements			
Parameter	Base	Quantity	Concentration	Monitoring Location	Sample Location	Measurement Frequency	Sample Type
Flow Rate	Monthly Total	M&R, Gallons per Month		Internal Monitoring Point	002	Continuous	Meter
TSS	Daily Max		M&R, mg/L	Internal Monitoring Point	002	Biweekly	Composite
Perchlorate	Daily Max		M&R, mg/L	Internal Monitoring Point	002	Biweekly	Composite

Note: M&R: Measure and Report; mg/L: milligrams per liter

Table 14 Discharge Limits for Outfall 003

Discharge Limitations				Monitoring Requirements			
Parameter	Base	Quantity	Concentration	Monitoring Location	Sample Location	Measurement Frequency	Sample Type
Flow Rate	Monthly Total	M&R Million Gallons		Effluent Gross	003	Continuous	Meter
pH, Minimum	Daily Minimum		≥ 6.5 STD Units	Effluent Gross	003	Biweekly	Grab
pH, Maximum	Daily Maximum		≤ 9.0 STD Units	Effluent Gross	003	Biweekly	Grab
TSS	Daily Max		≤ 135 mg/L	Effluent Gross	003	Weekly when Discharging	Composite
TDS	Daily Max		M&R, mg/L	Effluent Gross	003	Biweekly	Composite

Discharge Limitations				Monitoring Requirements			
Parameter	Base	Quantity	Concentration	Monitoring Location	Sample Location	Measurement Frequency	Sample Type
Perchlorate	Daily Max		18 µg/L	Effluent Gross	003	Weekly when Discharging	Composite
Manganese Total Recoverable	Daily Max		≤ 1.72 mg/L	Effluent Gross	003	Biweekly	Composite
Boron, Total (as B)	Daily Max		≤ 3.71 mg/L	Effluent Gross	003	Biweekly	Composite
Nitrogen, Inorganic Total	Daily Max		M&R, mg/L	Effluent Gross	003	Biweekly	Composite
Ammonia-N, Total	Monthly Average		M&R, mg/L	Effluent Net	003	Biweekly	Composite
Phosphorus, Total (as P)	Monthly Average	M&R (lbs/day)		Effluent Gross	003	Biweekly	Composite
Phosphorus, Total (as P)	Daily Max		M&R, mg/L	Effluent Net	003	Biweekly	Composite

Note: M&R: Measure and Report; mg/L: milligrams per liter; TDS: total dissolved solids

Table 15 Discharge Limits for Outfall 004

Discharge Limitations				Monitoring Requirements			
Parameter	Base	Quantity	Concentration	Monitoring Location	Sample Location	Measurement Frequency	Sample Type
TDS	Single Sample	(1)	2,400 mg/L	Downstream Monitoring	004	Monthly when Discharging	Discrete
Manganese Total Recoverable	Daily Max	(2)	≤ 200 µg/L	Downstream Monitoring	004	Monthly when Discharging	Discrete
Boron, Total (as B)	Daily Max	(2)	≤ 750 µg/L	Downstream Monitoring	004	Monthly when Discharging	Discrete

Note 1: Total Dissolved Solids: 95% of S. V. Samples <=2,400 mg/L (NAC 445 A. 2158 RMHQ)
Note 2: NAC 445 A. 1236 Standard for Toxic Materials Applicable to Designated Waters

8.3 SCHEDULE OF COMPLIANCE

Table 16 Schedule of Compliance Table

Item #	Description	Due Date
1	The permittee shall submit and obtain approval for final Operation & Maintenance (O&M) Manual, wet stamped by a Nevada licensed professional engineer, within 90 days of the permit effective date.	11/10/2017
2	Within 1 year of this permit issuance, all DMRs shall be submitted electronically through the Nevada website https://netdmr.dep.nv.gov/netdmr/public/home/htm	8/10/2018

8.4 SPECIAL APPROVALS/CONDITIONS

Table 17 Special Approvals/Conditions Table

Item #	Description	Due Date
1	If and when the construction activities at the Historic Lateral Weir renders the Outfall 004 inaccessible, upon Permittee's written request to the Bureau, the Permittee may be approved to collect samples from an alternative sampling point.	TBD

8.5 REPORTS AND SUBMITTALS

Table 18 Deliverable Schedule for Reports, Plans, and Other Submittals

Item #	Description	Interval	First Scheduled Due Date
1	Quarterly Discharge Monitoring Reports (DMRs)	Quarterly	10/28/2017
2	Annual Report	Annually	1/28/2018

8.5.1 Quarterly Reports

Monitoring results obtained pursuant to the NPDES permit for the previous 3-month period shall be summarized and tabulated for each month and reported on a DMR form. Quarterly reports shall be submitted for the quarterly periods corresponding to: January 1 through March 31, April 1 through June 30, July 1 through September 30, and October 1 through December 31. NDEP will receive each DMR no later than the 28th day of the month following the completed reporting period. If required, the Permittee will submit data in an electronic format approved by the Division. Any data submitted that exceed the limits delineated in the NPDES permit must be explained by a narrative. Summaries of laboratory results for analyses conducted by outside laboratories must accompany the DMR, and the full data package provided by the laboratory must be provided if requested in writing by the Division. If at any time the Permittee concludes that submitted data were incorrect, the Permittee shall notify the Division in writing, identify the incorrect data, and replace the incorrect data with corrected data, which shall thereafter be used for determining compliance with this permit.

8.5.2 Annual Reports

Pursuant to the schedule defined in Section A, DLV– Deliverable Schedule for Reports, Plans, and Other Submittals (DLV Table) of the NPDES permit, the Permittee shall submit a plot of concentration (y-axis) versus date (x-axis) for each analyzed constituent. The plot shall include data from the preceding 5 years or from the effective date of the permit, whichever is shorter. Exemption: Graphing is not required for any constituent that has been below the detection limit for every analysis during the current year and the previous 4 years of the monitoring period if not required by the previous permit. Graphing of less than three data points is not required. The Permittee must explain why the analyzed constituents have not been graphed in the DMR cover letter.

8.5.3 Compliance Reports

Reports of compliance or non-compliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date. Quarterly reports shall include documentation that identifies all

Sanitary Sewer Overflows (SSO) or spills that occurred at the permitted facility or within the treatment works during the previous quarter in accordance with the permittees SSO/Spill Reporting Procedures.

8.5.4 Planned Changes

The Permittee shall give notice to the Administrator as soon as possible of any planned alterations or additions to the permitted facility. Notice is required only when the alteration or addition is to a permitted facility.

8.5.5 Anticipated Non-Compliance

The Permittee shall give advance notice to the Administrator of any planned changes in the permitted facility or activity which may result in non-compliance with permit requirements. An original signed copy of these, and all other reports required herein, shall be submitted to the State at the following address:

Nevada Division of Environmental Protection
Bureau of Water Pollution Control
901 South Stewart Street, Suite 4001
Carson City, Nevada 89701-5249

8.5.6 Discharge Monitoring Reports

DMRs must be signed by the facility's highest ranking operator. The first DMR submitted under this permit must include the written designation of the operator required by NPDES permit, as the authorized representative to sign the DMRs. If the operator in charge changes, a new designation letter must be submitted. An original signed copy of these, and all other reports required herein, shall be submitted to the State at the following address:

Nevada Division of Environmental Protection
Bureau of Water Pollution Control
901 South Stewart Street, Suite 4001
Carson City, Nevada 89701

8.5.7 Recording the Results

For each measurement or sample taken pursuant to the requirements of this permit, the Permittee shall record the following information:

- The exact place, date, and time of sampling;
- The dates the analyses were performed;

- The person(s) who performed the analyses;
- The analytical techniques or methods used; and
- The results of all required analyses, including reporting limits.

8.5.8 Spill Notification

Table 19 Spill Notification

Contact	Phone Number
EMERGENCY	911
Henderson Fire Department	(702) 267-2222
Clark County Fire Department	(702) 455-7311
Nevada Environmental Response Trust – Steve Clough	(702) 686-9611
Henderson Emergency Management Coordinator	(702) 267-2212
NDEP 24-hour Spill Hotline (which notifies the county)	(888) 331-6337
National Response Center Hotline	(800) 424-8802
U.S. BOR, Hazardous Materials Coordinator	(702) 293-8130
Basic Environmental Company, LLC	(702) 567-0400

8.5.8.1 Reporting Thresholds

Agency notification of coolant and petroleum product release may be required, depending on the volume of the product release and whether the product reaches a water of the U.S. or shoreline. ***Table 20*** provides reporting thresholds for reporting coolant and petroleum releases to outside entities.

Table 20 Reporting Thresholds

Material	Quantity	Agency	When to Notify
Petroleum products	>25 gallons >3 cubic yards Any quantity affecting waters of the U.S.	NDEP Spill Hotline	Report as soon as possible but no later than the end of the first working day of the release.
	>25 gallons Off-site impacts When employees are at risk	Henderson Emergency Management Coordinator	Report as soon as possible after there is knowledge of a release.
	Any quantity causing a film, sheen, or discoloration of surface water or shoreline	National Response Center	Report immediately after there is knowledge of a release.
	Any quantity causing a sludge or emulsion beneath the water surface or shoreline	National Response Center	Report immediately after there is knowledge of a release.
	>1 gallon	U.S. BOR	Report spills on BOR land (HLPS) within 24 hours, according to the terms of the Categorical Exclusion finding under the National Environmental Policy Act.
	1 release >1,000 gallons, or	EPA	Within 60 days.

Material	Quantity	Agency	When to Notify
	2 releases >42 gallons each, into navigable water within a 12-month period		
Coolant	> 25 gallons of contaminated material >3 cubic yards of contaminated material Any quantity present in groundwater or affects a water way	NDEP Spill hotline: In-state: 1-888-331-6337	Report as soon as possible, but no later than the end of the first working day of the release.

8.5.8.2 NPDES Spill provisions

The NPDES permit contains the following spill response requirements:

- Any diversion, bypass, spill, or overflow to navigable waters is prohibited unless it was unavoidable to prevent loss of life, personal injury, or severe property damage (Section C.8.7.1)
- The Permittee shall notify the Administrator at (775) 687-9418 during normal business hours and through the NDEP Spill Hotline at (888) 331-6337 within 24 hours after identifying a diversion, bypass, spill, or overflow that imminently and substantially endangers human health, the environment, or reaches waters of the state. A written report shall be submitted within 5 days (Section C.8.2)

NERT (Mr. Steve Clough) should be notified immediately upon discovery of a spill.

9.0 DATA COLLECTION AND MANAGEMENT

The Treatment Plant consists of cyclones to remove large solids, Multi-Media Filters to remove finer solids, followed by ion exchange to remove perchlorate. The cyclones and Multi-Media Filters are included to protect the Ion Exchange System against plugging and short circuiting. Data collection involves obtaining operational data and collecting samples for laboratory analysis.

9.1 OPERATIONAL DATA

The key operational parameters that must be closely monitored are 1) flow rate, 2) suspended solids concentrations, and 3) perchlorate concentrations in various streams. An example Data Management Spreadsheet has been created to help operators collect and record data on a daily basis as shown in ***Table 21***. A brief description of the data that is collected is discussed in the following subsection.

9.1.1 Flow Rate

Magnetic flow meters installed on several streams measure the instantaneous and totalized flow for the particular streams. The average daily flow is calculated by the PLC by dividing the totalized flow for the stream by 1,440 min/day. The PLC will also record and report the daily maximum flow for particular streams. The average daily and daily maximum flows is recorded for the following streams:

- Influent to HLPS
- Influent to SMPS
- Combined flow to CWTP
- Cyclone underflow (daily average only)
- Backwash waste (daily average only)
- Treated water effluent

9.1.2 Total Suspended Solids

Online TSS analyzers installed on several streams measure instantaneous TSS concentration in the particular streams. The data is sent to the PLC. The PLC will record the instantaneous and daily average TSS values for various streams. This information is recorded in the Data Management Spreadsheet for the following streams:

- Influent to HLPS
- Influent to SMPS
- Combined flow to CWTP
- Cyclone overflow to Multi-Media Filters
- Multi-Media Filters effluent to Ion Exchange System
- Backwash waste
- Treated water effluent

9.1.3 Perchlorate Concentration

The operators will collect daily samples from various streams and analyze them for perchlorate. As indicated, the Ion Exchange System is designed to remove perchlorate from groundwater. The concentration of perchlorate in the lead/lag tanks from the Ion Exchange System will provide information about the capacity of the Ion Exchange System. It will also alert the operator to when he needs to call the ion exchange supplier to schedule resin replacement in a particular ion exchange tank. The following streams are sampled daily and analyzed for perchlorate:

- Influent to HLPS

- Influent to SMPS
- Combined flow to CWTP
- Cyclone underflow
- Backwash waste
- Ion Exchange IX-1A and IX-2A lead tank/lag tanks effluents
- Ion Exchange IX-1B and IX-2B lead tank/lag tanks effluents
- Ion Exchange IX-1C and IX-2C lead tank/lag tanks effluents
- Treated water effluent

Additional details regarding daily sample collection and laboratory analysis for perchlorate is included in Section 9.2.1

Table 21 Data Management Spreadsheet

NERT - SNWA WEIR DEWATERING TREAMENT PLANT
DATA MANAGEMENT SPREADSHEET

Date	Daily Flow (gpm)										Daily Average TSS (mg/L)							Perchlorate (mg/L)											
	Influent						Cyclone Underflow	Backwash	Effluent		Influent			Cyclone Effluent	Multi-Media Filters Effluent	Backwash	Effluent	Influent			Cyclone Underflow	Backwash	Ion Exchange System						Effluent
	HLPS		SMPS		Combined Feed						HLPS	SMPS	Combined					HLPS	SMPS	Combined			IX-1A	IX-2A	IX-1B	IX-2B	IX-1C	IX-2C	
	Avg.	Max.	Avg.	Max.	Avg.	Max.			Avg.	Max.																			

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9.2 SAMPLE COLLECTION AND ANALYSIS

9.2.1 Daily Sample Collection and Laboratory Analysis

Table 22 provides a summary of water samples collected on a daily basis for laboratory analysis.

Table 22 Sample Collection and Analysis

Sample Location	Frequency	Sample Type	Parameter
HLPS Influent	Daily	Grab	Perchlorate
SMPS Influent	Daily	Grab	Perchlorate
Outfall 001	Daily	Grab	Perchlorate
Lead IX Tanks Effluent	Daily	Grab	Perchlorate
Lag IX Tanks Effluent	Daily	Grab	Perchlorate
Outfall 002	Daily	Grab	Perchlorate
Outfall 003	Daily	Grab	Perchlorate

The objective of this sampling program is to ensure that the Treatment Plant operates as expected within regulatory limits. A brief description of sample locations follows.

Historic Lateral Pump Station

SNWA will deliver groundwater generated from dewatering at the Historic Lateral Weir construction site to the Influent Tanks at the HLPS, where the water is stored before it is pumped to the CWTP. One sample is collected from the influent groundwater to the HLPS and analyzed for perchlorate. The perchlorate concentration in the water from HLPS is expected to be less than 1 ppm.

Sunrise Mountain Pump Station

SNWA will deliver groundwater generated from dewatering at the Sunrise Mountain Weir construction site to the Influent Tanks at the SMPS, where the water is stored before it is pumped to the CWTP. One sample is collected from the influent groundwater to the SMPS and analyzed for perchlorate. The perchlorate concentration in the water from SMPS is expected to be less than 2 ppm.

Outfall 001 (Feed Water to CWTP)

Outfall 001 is designated as Internal Structure which is the Combined Influent from SMPS and HLPS at CWTP. The water from SMPS and HLPS is combined in a common line to feed the CWTP prior to entering the cyclones. The perchlorate concentration in this stream should be the flow-weighted average concentration from the HLPS and the SMPS. The concentration in the feed stream can also be calculated using the following relationship:

$$(P)_{Feed} = [(P)_{HLPS} \times (F)_{HLPS} + (P)_{SMPS} \times (F)_{SMPS}]/[(F)_{HLPS} + (F)_{SMPS}]$$

Where:

$(P)_{Feed}$ = Perchlorate concentration in feed water

$(P)_{HLPS}$ = Perchlorate concentration in HLPS water

$(F)_{HLPS}$ = Water flow rate at HLPS

$(P)_{SMPS}$ = Perchlorate concentration in SMPS water

$(F)_{SMPS}$ = Water flow rate at SMPS

9.2.2 NPDES Data Collection and Management

The operator will collect samples from the NPDES outfalls as described in the NPDES Permit. The samples are submitted to an outside laboratory for analysis. The permit provides detailed description on the following items for each outfall:

- Sample Location
- Sample Type (Grab, Composite, or Discrete)
- Sample Frequency (Weekly, Biweekly, or Monthly)
- Parameters to be Analyzed
- Concentration Limit

Appendix I provides example spreadsheets for NPDES data management. The operator should refer to Section 8.0 for detailed description of NPDES sample collection and analysis requirements.

9.2.2.1 Biweekly Sample Collection and Analysis for NPDES Outfalls 001, 002, and 003

As indicated earlier, Outfall 001 is designated as Internal Structure which is the combined influent from the SMPS and the HLPS at the CWTP. The NPDES Permit has set measure and report requirements for several parameters for this stream. ***Table 23*** summarizes the frequency of sampling, sample type, the parameters to be analyzed, and where analysis is to be performed for Outfall 001. A composite sampler is used to collect samples from Outfall 001 on a biweekly basis. Samples will be sent to TestAmerica for analysis. They will be analyzed for perchlorate, TSS and TDS. The pH of the composite sample will be measured in-house.

Table 23 Outfall 001 Sample Collection and Analysis

Frequency	Sample Type	Parameter	Analysis
Biweekly	Composite	Perchlorate	TestAmerica
Biweekly	Composite	TSS	TestAmerica
Biweekly	Composite	TDS	TestAmerica
Biweekly	Grab	pH	In-House

Outfall 002 is designated as the Internal Outfall, which is the Backwash Waste Pump discharge line. The Internal Outfall is the stream that transfers backwash waste to the Backwash Waste Tank. This stream contains high levels of TSS. The backwash waste from the Backwash Waste Tank is blended with treated water from the Treated Water Tanks and the combined stream is discharged to the Las Vegas Wash. Therefore, the operators need to monitor the TSS concentration in the discharge stream carefully to ensure that it is lower than the discharge limit. An online TSS meter is installed on the discharge line. ***Table 24*** summarizes the frequency of sampling, sample type, the parameters to be analyzed, and where analysis is to be performed for Outfall 002.

Table 24 Outfall 002 Sample Collection and Analysis

Frequency	Sample Type	Parameter	Analysis
Biweekly	Composite	Perchlorate	TestAmerica
Biweekly	Composite	TSS	TestAmerica

Outfall 003 is designated as the External Outfall, which is the treated effluent that is discharged to the Las Vegas Wash. The NPDES Permit has imposed limits on several parameters. ***Table 25*** summarizes the frequency of sampling, sample type, the parameters to be analyzed, and where analysis is to be performed for Outfall 003. Except for perchlorate and TSS, samples are collected biweekly. For perchlorate and TSS, samples are collected when water is being discharged on a weekly basis. A composite sampler is used to collect samples for Outfall 003. Samples are sent to TestAmerica for analysis.

Table 25 Outfall 003 Sample Collection and Analysis

Frequency	Sample Type	Parameter	Analysis
Weekly When Discharging	Composite	Perchlorate	TestAmerica
Weekly When Discharging	Composite	TSS	TestAmerica
Biweekly	Composite	TDS	TestAmerica
Biweekly	Composite	Total Manganese	TestAmerica
Biweekly	Composite	Total Boron	TestAmerica
Biweekly	Composite	Total Inorganic Nitrogen	TestAmerica
Biweekly	Composite	Total Ammonia-N	TestAmerica
Biweekly	Composite	Total Phosphorous	TestAmerica

9.2.2.2 Monthly Sample Collection and Analysis for NPDES Outfall 004

Outfall 004 is designated as Receiving Water--Ambient, which is the end of mixing zone ambient wash water quality monitoring point. This point is a predetermined location downstream of point where discharge water from Outfall 003 has mixed with water in the Las Vegas Wash. ***Table 26*** summarizes the frequency of sampling, sample type, the parameters to be analyzed, and where analysis is to be performed for Outfall 004. Discrete samples are collected on a monthly basis when water is being discharged. Samples are sent to TestAmerica laboratory for analysis of TDS, total recoverable manganese, and total boron (as B).

Table 26 Outfall 004 Sample Collection and Analysis

Frequency	Sample Type	Parameter	Analysis
Monthly When Discharging	Discrete	TDS	TestAmerica
Monthly When Discharging	Discrete	Total Manganese Recoverable	TestAmerica
Monthly When Discharging	Discrete	Total Boron (as B)	TestAmerica

10.0 SAMPLE CALCULATIONS

This section provides sample calculations for common operational situations that require evaluation.

10.1 FLOW CALCULATIONS

Flow meters are installed at several locations at the Treatment Plant. These flow meters measure instantaneous flow and also totalized flow for every 24 hours per day. It should be noted that the only accurate way to determine the average daily flow for a given stream is to use the totalized flow for that stream (gallons/day) and divide it by the 1,440 (minutes/day).

10.1.1 Average Daily Flow at Sunrise Mountain Pump Station

The average daily flow for the SMPS can be calculated from totalized flow for that day.

Equation:

$(\text{Flow})_{\text{AVG}} = (\text{Flow})_{\text{Daily Total}}\ \text{gal} / 1{,}440\ (\text{minutes/day})$

Assumption:

$(\text{Flow})_{\text{Total}} = 3{,}456{,}000\ \text{gal/day}$

Calculation:

$(\text{Flow})_{\text{AVG}} = [3{,}456{,}000\ (\text{gal/day}) / 1{,}440\ (\text{minutes/day})] = 2{,}400\ \text{gpm}$

10.1.2 Average Daily Flow at Historic Lateral Pump Station

The average daily flow for the HLPS can be calculated from totalized flow for that day.

Equation:

$(\text{Flow})_{\text{AVG}} = (\text{Flow})_{\text{Total}}\ \text{gal} / 1{,}440\ (\text{minutes/day})$

Assumption:

$(\text{Flow})_{\text{Total}} = 3{,}024{,}000\ \text{gal/day}$

Calculation:

$(\text{Flow})_{\text{AVG}} = [3{,}024{,}000\ (\text{gal/day}) / 1{,}440\ (\text{minutes/day})] = 2{,}100\ \text{gpm}$

10.1.3 Total Average Daily Influent Flow

Total average daily flow for the influent stream can be calculated from the total average daily flow for the two pump stations.

Equation:

$(\text{Flow})_{\text{Influent}} = (\text{Flow})_{\text{AVG SMPS}}\ \text{gal} + (\text{Flow})_{\text{AVG HLPS}}\ \text{gal}$

Assumption:

$(\text{Flow})_{\text{AVG SMPS}} = 1{,}800\ \text{gpm}$

$(\text{Flow})_{\text{AVG HLPS}} = 2{,}150\ \text{gpm}$

Calculation:

$(Flow)_{Influent} = 1{,}800 + 2{,}150 = 3{,}950$ gpm

10.1.4 Hydraulic Balance around Any Unit Operation

Several flow meters are installed at the inlet and outlet from various unit operations. In the event one of these flow meters is faulty, a hydraulic balance may be used to determine the particular flow. For example, if the flow meter on the cyclone underflow line is broken, the inlet flow to and outlet flow from the cyclone can be used to calculate the missing underflow flow rate.

Equation:

$(Flow)_{Influent\ Cyclone} = (Flow)_{Effluent\ Cyclone}\ gal + (Flow)_{Underflow\ Cyclone}\ gal$

$(Flow)_{Underflow\ Cyclone} = (Flow)_{Influent\ Cyclone}\ gal - (Flow)_{Effluent\ Cyclone}\ gal$

Assumption:

$(Flow)_{Influent\ Cyclone} = 4{,}600$ gpm

$(Flow)_{Effluent\ Cyclone} = 4{,}562$ gpm

Calculation:

$(Flow)_{Underflow\ Cyclone} = 4{,}600 – 4{,}562$

$(Flow)_{Underflow\ Cyclone} = 32$ gpm

10.1.5 Hydraulic Balance Around Treated Water Tanks

Treated water from Ion Exchange System is sent to the Treated Water Tanks. Also, backwash waste from the Backwash Waste Tank is sent to the Treated Water Tanks. From the Treated Water Tanks, discharge is pumped to the Las Vegas Wash. and also Rinse and Backwash water is sent to the Multi-Media Filters. Here is the hydraulic balance:

Equation:

$(Flow)_{Discharge} + (Flow)_{Rinse/Backwash} = (Flow)_{IX\ Effluent} + (Flow)_{Backwash\ Waste}$

Where,

$(Flow)_{Discharge}$ = Discharge flow to the Las Vegas Wash (gpm)

$(Flow)_{Rinse/Backwash}$ = Water used for rinsing and backwashing the filters (gpm)

$(Flow)_{IX\ Effluent}$ = Ion exchange effluent flow (gpm)

$(Flow)_{Backwash\ Waste}$ = Flow from the Backwash Waste Tank to the Treated Water Tanks (gpm)

Assumption:

$(Flow)_{Discharge}$ = Unknown

$(Flow)_{Rinse/Backwash} = 3{,}000$ gpm

$(Flow)_{IX\ Effluent} = 4{,}600$ gpm

$(Flow)_{Backwash\ Waste} = 2{,}000$ gpm

Calculation:

$(Flow)_{Discharge} = (4{,}600 + 2{,}000 - 3{,}000)$

$(Flow)_{Discharge} = 3{,}600$ gpm

It should be noted that these calculations are instantaneous flow calculations. In order to conduct a hydraulic balance on any unit operation using the average daily flows, the totalized flows for each stream should be used to calculate daily average flows before the hydraulic balance can be done.

10.2 PERCHLORATE BALANCE

The Treatment Plant is designed to primarily remove perchlorate from water. It is anticipated that the perchlorate concentration from the water coming from the two pump stations will be different. Samples will be collected from various streams on a daily basis to monitor perchlorate concentrations in the Treatment Plant.

10.2.1 Perchlorate Concentration in the Influent Stream

Perchlorate concentration in the influent stream can be calculated from the perchlorate concentrations in the water coming from the SMPS and HLPS.

Equation:

$(PC)_{Influent} = [(PC)_{SMPS} \times (Flow)_{SMPS} + (PC)_{HLPS} \times (Flow)_{HLPS}] / [(Flow)_{SMPS} + (Flow)_{HLPS}]$

Where,

$(PC)_{Influent}$ = perchlorate concentration in the influent stream;

$(PC)_{SMPS}$ = perchlorate concentration in the water coming from SMPS;

$(Flow)_{SMPS}$ = Average daily flow from SMPS

$(PC)_{HLPS}$ = perchlorate concentration in the water coming from HLPS;

$(Flow)_{HLPS}$ = Average daily flow from HLPS;

Assumption:

$(PC)_{SMPS} = 1.8$ ppm

$(Flow)_{SMPS} = 2{,}200$ gpm

$(PC)_{HLPS} = 0.95$ ppm

$(Flow)_{HLPS} = 1{,}850$ gpm

Calculation:

$(PC)_{Influent} = [(1.8) \times (2{,}200) + (0.95) \times (1{,}850)] / [(2{,}200 + 1{,}850)]$

$(PC)_{Influent} = 1.41$ ppm

10.2.2 Daily Average Perchlorate Mass in the Influent Stream

The daily average perchlorate mass in the influent stream can be calculated from daily average influent flow and daily average perchlorate concentration.

Equation:

$(PM)_{Influent} = \{[(Flow)_{Influent} \times 1{,}440 \text{ (minutes/day)} \times 8.34 \text{ (lbs. /gal} \times (PC)_{Influent}] / [1{,}000{,}000 \text{ (ppm/lb.)}]\}$

Where,

$(PM)_{Influent}$ = Mass of perchlorate in influent stream (lbs. /day)

$(Flow)_{Influent}$ = Influent Average daily flow (gpm)

$(PC)_{Influent}$ = Perchlorate concentration in the Influent stream (ppm)

8.34 lbs/gal= Density water at standard temperature and pressure for unit conversion

1,000,000 (ppm/lb.) = Conversion factor converting ppm to lbs.

Assumption:

$(Flow)_{Influent}$ = 4,600 gpm

$(PC)_{Influent}$ =1.41 ppm

Calculation:

$(PM)_{Influent}$ = {[$(Flow)_{Influent}$ x 1,440 (minutes/day) x 8.34 (lbs. /gal x $(PC)_{Influent}$] / [1,000,000 (ppm/lb.)]}

$(PM)_{Influent}$ = (4,600 x 1,440 x 8.34 x 1.41)/1,000,000

$(PM)_{Influent}$ = 77.89 lbs./day

10.2.3 Total Suspended Solids Concentration Balances

There are online TSS measuring devices at several locations in the Treatment Plant. TSS is a key process control parameter. Since the solids that are removed from the feed water in the cyclones and the Multi-Media Filters are blended back with the treated wastewater, it is important to keep track of TSS in the treatment process. Similar to hydraulic and perchlorate balances described in previous sections, the operator can conduct TSS balances around any unit operation.

10.2.4 Total Suspended Solids Balance around Treated Water Tanks

Every stream that enters or leaves the Treated Water Tanks contain TSS. The TSS concentration in the backwash waste stream is very high. The backwash waste stream is sent to the discharge pipe at the outlet of the Treated Water Tanks. Here is the TSS balance on Discharge line:

Equation:

$(TSS)_{Discharge}$ = {[$(TSS)_{IX\ Effluent}$ x $(Flow)_{IX\ Effluent}$ + $(TSS)_{Backwash\ Waste}$ x $(Flow)_{Backwash\ Waste}$]/
[$(Flow)_{IX\ Effluent}$ + $(Flow)_{Backwash\ Waste}$]}

Assumption:

$(TSS)_{Discharge}$ = Unknown

$(TSS)_{IX\ Effluent}$ = 10 ppm

$(Flow)_{IX\ Effluent}$ = 4,600 gpm

$(TSS)_{Backwash\ Waste}$ = 4,000 ppm

$(Flow)_{Backwash\ Waste}$ = 50 gpm

Calculation:

$(TSS)_{Discharge}$ = [(10 x 4,600) + 4,000 x (50)]/(4,600 + 50)]

$(TSS)_{Discharge}$ = 53 ppm

11.0 HEALTH, SAFETY, AND SECURITY

11.1 GENERAL

The NERT weir de-watering treatment plant operations at the CWTP and two pump stations must also address personnel health, safety and security. A hazard assessment of all planned operations and maintenance activities, work locations and equipment should be performed by the contractor to identify potential chemical, physical, biological and environmental hazards and to evaluate the risk of worker illness or injury that may occur during routine and non-routine operations. Appropriate hazard controls should be identified including engineering controls, administrative controls and personal protective equipment. The hazard assessment should be conducted by project management, health and safety professionals, and the assigned operator(s) in advance of treatment plant operations start-up. Health and safety evaluations should be documented in a written document, such as a Health and Safety Plan and Job Safety Analysis (JSA). These documents must be developed to comply with all applicable Federal, state and local requirements including the Nevada Occupational Safety and Health Administration (OSHA) standards. This includes compliance with the OSHA Hazardous Waste and Emergency Response (HAZWOPER) Standard (29 CFR 1910.120) and applicable sections of 29 CFR Part 1910 (General Industry Standards) and Part 1926 (Construction Standards).

Health and safety planning should also include emergency response plans and site security. The contents of this Operations and Maintenance manual as well as the health and safety plan should be the primary references for operator training. These documents should be reviewed at least annually and revised as needed to address any significant changes in processes, equipment, hazards, and personnel that could impact site health and safety.

Site activities performed by specialty firms and lower tier subcontractors should also address task health and safety concerns through the pre-mobilization submittal of safe work plans, and contractor orientation and training on the first day of work.

11.2 SITE-SPECIFIC HEALTH AND SAFETY CONSIDERATIONS

Site health and safety requirements should address operator qualifications and competencies, medical monitoring, and operator training and information on HAZWOPER, heat illness prevention and monitoring, chemical hazard communication, fall protection, overhead hazards, slip/trip/fall hazards, working over or near water, PPE, emergency equipment, spill prevention and containment, lockout/tagout controls, lone worker safety, first aid/CPR, extreme weather, vehicle traffic, and other subjects. Copies of all required health and safety records including the health and safety plan, job safety analyses, training, inspections, etc. must be kept onsite.

Authorized visitors to the pump stations and treatment plant include service personnel (electricians, construction employees, instrument repair, etc.), technical visitors (consulting engineers, regulatory agency, other operators, salesmen, etc.), and non-technical groups (school tours, news media, ecology groups, etc.). The method of providing for the safety of visitors will vary with the type of visitor or group of visitors.

The following general provisions should be made for visitors:

1) Visitors should be directed to report to the field office.
2) A logbook must be provided for visitors to register their names, addresses, company representation, and reason for visit.
3) Areas requiring special precautions should be clearly designated. Hazardous areas should be roped off when groups of visitors are expected.
4) Groups of visitors should be kept together. An escort may be required for visitors.
5) All groups should be briefed on safety prior to visiting plant units.

6) Personal protective equipment (PPE) should be available for the visitors and should be appropriate to the areas to be visited (e.g., safety glasses, safety vest, hard hat, hearing protection).

7) All site safety rules must be strictly followed. This includes enforcement of NO SMOKING requirements and wearing of required PPE.

Special requirements of service personnel should be determined when these people visit the plant. Such visits may require assistance, special lighting or tools, and working at other than normal shift times.